THE INTERNATIONAL SUGAR JOURNAL.

A TECHNICAL AND COMMERCIAL PERIODICAL DEVOTED ENTIRELY TO THE SUGAR INDUSTRY.

JANUARY TO DECEMBER,

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THE

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Outlook in 1923.

With the passing of 1922 there disappears the leanest trading year the sugar industry has experienced for a long while or is likely to experience again, as one must hope. Not merely for the sugar producers was it an unremunerative year, but it was a period of stagnation in the industries supplying the sugar manufacturers with their plant and accessories. The former marketed most of their sugar before the recent rise in sugar prices offered scope for a more remunerative return; the latter have been the victims of a determination on the part of their customers to withhold orders, either because they had not in sight the funds wherewith to warrant an expenditure on new apparatus, or, as in many cases, because they were waiting till the bottom of the market prices was reached or thought to be reached. The result was a general lack of orders for machinery and other supplies.

But as sugar was cheap, it sold freely; indeed the consumption was so unexpectedly good that the large surplus of sugar which overloaded the market at the beginning of 1922 disappeared almost like magic and the 1922 crops have also gone well. As a consequence, there is every prospect that the 1922-23 crops will sell equally well; some opinions indeed incline to the view that there will be insufficient sugar available for the world's demand during 1923, and that therefore a further rise in price may be expected.

Whether this latter view is over-sanguine the next few months will show; what is obvious is that the sugar industry can no longer plead the comparative poverty of 1922 as a reason for continuing to play a waiting game. Prices of plant and accessories have come down during 1922 mainly owing to cheaper wages in the engineering industry, but just lately there have been indications that prices were tending to harden again. As a consequence enquiries for machinery have once more been brisk in many quarters, and it is to be hoped that before very long orders will follow. They will need to, if they are to be of use for the 1923-24 sugar season.

At home the belief in general trading circles as to 1923 is one of hopefulness without any expectation of a great revival. It is better though that the revival of trade all round should be gradual than that it should develop periods of marked fluctuations. The amount of unemployment in this country, though now lessening,

has been and is still very great, and this has had an effect on the sugar consumption during the last quarter of the year that has nullified the promise held out by the earlier months. A steady trade revival during 1923 should revive the sugar consumption in this country, especially if the new Chancellor of the Exchequer, Mr. STANLEY BALDWIN, can be induced to moderate the amount of the duty on sugar. At present it virtually doubles the cost of this article to the purchaser, and though it ranks as one of the best means of indirect taxation that we have in this country, it is excessive in that it has a repressive effect on consumption. As the Budget day draws nearer we shall doubtless hear of strong representations being made from more than one quarter for a reduction. The difficulty will be that unless the Imperial preference is cast on slightly different lines, any reduction in the sugar duty will lessen the preference *pro rata*, and this is not in the least to be desired at a time when the British sugar industry is struggling to recover from two very lean years. The present Government are however more consistently in favour of the idea of Imperial preference than was the late Coalition Government, and we have little doubt that they will endeavour to arrive at an equitable solution of the problem, should it arise.

Cuban Affairs.

Cuba has certainly made a remarkable recovery from the disastrous slump that visited her sugar industry in 1920-21. Not that she has made good all her losses or yet put her finances on a fully satisfactory basis; but the bedrock of her prosperity, the sugar production, has witnessed during 1922 a marked activity which has been enhanced by the unexpected demand from all quarters for the stocks of sugar available in the island. The result is she has sold all her old sugars and practically all the 1922 crop at a not unsatisfactory price, and she starts on the new campaign with the prospect of at least as good a crop as the last one, at a better price still. A year ago, Cuba was only too glad to find a customer for her sugar; now she is indisposed to accept the first offer and is selling the new crop very sparingly in the hope that in a month or two she will be able to ask, and get, a more remunerative price. She knows that there are over a million tons less Cuban sugar available for 1923 than was the case for 1922, and, if consumption in the coming year is anything like that of 1922, the shortage is likely to reflect itself in a further upward trend of prices.

It is not surprising then to learn that projects are on foot to add to the number of modern Cuban sugar factories. Two are projected while extensions to others are also mooted. Raw sugar factories apart, there is also a proposal in more than one quarter to erect refineries in Cuba to refine the locally-produced 96 test sugar on the spot and then ship it to Europe. One Cuban party, we gather, has been over in this country trying to raise capital for such a refinery, which it is proposed should cost about two million pounds sterling and be capable of turning out a large amount of refined for the British market. There have also been in Havana Swiss investors looking into a like proposition with a view to refining sugar and shipping it to Europe. Whether these proposals will be received with sufficient welcome as to ensure that the capital is forthcoming, remains to be seen; but there is no doubt that, sooner or later, Cuba will endeavour to be in large part its own refiner as well as raw sugar producer, and that the overseas refineries will have an additional competitor to deal with. Not that Cuba is the only recruit; Canada is thinking of taking a hand in the refining game, for her beet sugar plants could be turned into "refineries" during the dead season. It is only necessary to add a washing station to the present white

sugar installation, so we hear it is not unlikely that her chief factories may decide to make the experiment, drawing, we presume, on Cuba for their raw supplies.

Other things equal, we should prefer to see British capital put into schemes that would develop the production of cane sugar within the British Empire and so enlarge our sources of supply. It is not to the good of this country that we should be so dependent on one tropical region—and that a foreign one—for our large sugar consumption, which within a few years may attain to as much as two million tons per annum. But, undoubtedly, the presence in Cuba of one or two big refineries would tend to ward off the grip the American refining houses endeavour to obtain on Cuban raw sugar, and to that extent would bring along a freer competitive market in refined.

Production of Synthetic Sugar!

In the early part of December, newspapers in this country appeared with headlines such as "Sugar made by Chemists"; "Synthetic Food"; "Sugar produced in a Laboratory"; and the like. One member of the press, the *Observer*, remarked that: "To the man in the street there may be little worthy of notice in the announcement just made that sugar has been manufactured in the laboratories of Liverpool University by a chemical process, but this achievement is not only a great scientific victory, but it has a supremely important bearing on the future food supply of the world . . . ." And the *Daily News* published a leader, the ridiculous tenor and style of which may be judged by the following extracts: "British scientists have put their finger on one of the greatest questions of all time. The research chemists of Liverpool have made a greater discovery perhaps than those of Columbus and Copernicus. It is not in their case a question of finding a continent or universe, but of one of the secrets of being. They have seen life growing out of death, a breath of gas, a drop of water becoming the living material from which the whole vegetable world is built up . . . The chemist can now make sugar in his test-tubes and bottles. But the range of the new discovery's effects will be of more value than sugar. This is the kind of idea which changes man's whole attitude to life and brings him a stage nearer to the mastery of his destiny . . . ."

In explanation of this effusion, it may be pointed out that the Chancellor of the University of Liverpool at the annual meeting of the Court had called attention in his Report (which had been issued to the press) to the very interesting work recently conducted by Prof. E. C. C. Baly, to which attention has already been directed in our columns.[1] This chemist described experiments on the production in the laboratory of formaldehyde and certain simple monosaccharides (the identity of which does not appear yet to have been established), the substances from which this synthesis had been effected being water and carbon dioxide. At the recent Edinburgh meeting of the British Association, Prof. Baly had explained that by exposing a weak solution of carbon dioxide in water to the effect of ultra-violet light of short wave length, he had been able to synthesize formaldehyde and also substances which apparently were hexose sugars. He also pointed out that the combination was made possible by the use of chlorophyll, malachite green, and other coloured substances acting as a photo-catalyst by absorbing the visible light and radiating it at frequencies capable of absorption by the carbon dioxide and water; and he further emphasized the fact that there was difficulty in controlling

[1] *I.S.J.*, 1921, 641.

the reaction, owing to the fact that under the influence of the light of short wave length the saccharide substance was decomposed almost as soon as it was formed.

Prof. Baly's synthesis is certainly a notable achievement, highly interesting to the bio-chemist; but, of course, it is going much too far to state, as does the *Daily News*, that "life which has been the supreme mystery of all the ages has yielded half its secrets to them" (i.e., the Professor, and his collaborators), the observation of the action of light in effecting chemical changes not being new, but on the contrary very old. Nor is there any truth in the statement of the newspaper leader writer that this synthesis explains the conversion of inanimate into animate life. In fact, these comments on the part of the press regarding Prof. Baly's work form another example of "newspaper science." As we remarked quite recently in connexion with the discovery by journalists that sugar grows on trees,[1] it certainly does seem surprising that the press in this country do not seek guidance in scientific matters from specialists in the same way that they call upon the advice of experts in various branches of literature, music, and art. Had this been done in this case, the headlines and mis-statements to which we have called attention would not have been printed; and the great difference between the simple form of carbohydrate that has been synthesized and the sugar of commerce would have been explained. Further, the reader would probably have been told that, if the saccharine substance proved to be of the nature of dextrose (which, anyway, possesses only about 60 per cent. of the sweetness of sucrose) there could hardly be any significance in the discovery from the commercial point of view, at this stage at any rate, owing to the great difficulty in controlling the reaction. Even assuming for a moment that it were practicable to synthesize the disaccharide sucrose by a similar reaction, and that one could manage so to control the process that a high yield resulted, one can hardly conceive that it would be possible to produce or collect the necessary raw material, viz., carbon dioxide, at a lower cost than that at which nature is capable of forming the finished product, viz., sucrose, in the cells of the cane or beet.

The Sugar Industry in the British West Indies, 1921-22.

A Report for the year ending June 30th last on the Trade of the British West Indies, compiled by H.M. Trade Commissioner's Office, Trinidad,[2] has just been issued to the public. In this Report we are reminded that the prosperity of most of the West Indian colonies depends upon the cultivation of the sugar cane. "In Barbados sugar, syrup, and rum, are practically the only articles of export, and in British Guiana, Trinidad, Jamaica and some of the Leeward and Windward Islands cane cultivation gives employment to the majority of the population. Furthermore, the Colonial Governments look to the excise duties on rum and the export duties on cane products to provide a large proportion of the revenue (in Trinidad this proportion is one-third). The results of the cane crop, the cutting and grinding of which had just ended, indicated that, although some colonies had had another bad year, the total production of the British West Indies had certainly exceeded that of 1921. Estates and cane farmers experienced great difficulty in repaying loans, and, consequently, in making fresh borrowings against the 1921-22 crop." [The relief afforded by the Colonial Governments in Jamaica, British Guiana and Barbados, is outlined below.] "As in the case of other products the export duties on sugar and rum were reduced or dropped altogether. Although it was generally

[1] *I.S.J.*, 1921, 243.

[2] Report on Economic and Financial Conditions in the British West Indies: June 30th, 1922. By Mr. A. W. H. HALL (H.M. Stationery Office. 1s. net).

admitted that the Colonial Governments could do no more to assist this important industry, West Indian merchants felt that this help would not be sufficient to save it. The new American Customs tariff admits sugar from American territory free of duty, and places a tax of about £9 per ton on foreign sugars. This preference of £9 compares with the United Kingdom preference of about £4. The inability of the Cuban producers to place more than a small part of their huge production in the United States makes it necessary for them to attempt to dump the balance on the British and Canadian markets. It has, therefore, been urged that the British Government should assist the West Indian producers to meet this powerful competition by granting a preference on Empire produced sugars equal to that given by the United States to her colonials. Representations on this point made by the various sugar producing colonies have been unsuccessful, but, meanwhile, there has been a steady rise in the market price of sugar which has relieved the present situation to some extent. The future of the sugar industry in the British West Indies is therefore very uncertain. There are signs that unless there is a great improvement in the prospect for Empire sugar, production in British Guiana and Jamaica will decrease. This may also be true of the other producing colonies, but the movement towards reduced production is not so evident at present. A satisfactory feature this year is the marked increase in the exports of sugar to Canada. The difficulties of sugar factories are further increased by the total absence of demand for rum, large stocks of which are on hand in both the United Kingdom and the British West Indies. There are nearly 1,000,000 gallons in Jamaica alone, while the stocks in the United Kingdom exceed 11,000,000 gallons. Among the efforts to solve the problem of the utilization of this by-product of the sugar industry may be mentioned the manufacture of industrial alcohol in British Guiana for local use and of bay rum in St. Lucia."

Government Schemes for assisting Sugar Production in B.W.I.

As regards the relief afforded by the Colonial Governments in Jamaica, British Guiana and Barbados, this took the form of loans. "In Jamaica the Government borrowed from the three local banks at 7 per cent. sums of money which they advanced to sugar planters at 8 per cent. This scheme involved the marketing of the sugar by the Sugar Loan Committee, and similar legislation has been re-enacted this year. In British Guiana approved loans to sugar planters at a rate of interest not exceeding 6 per cent. were guaranteed by the Government. If the lender has to take advantage of the Government guarantee, repayment of the loan has to be made by the borrower to the Government within seven years. In the same colony legislation was introduced on behalf of the rice farmers, the Government advancing money on approved securities through the local co-operative banks through which the resulting crops must be marketed. In the Sugar Industry Agricultural Ban, Barbados already has an organization for financing the crops, but the inability of planters to repay their borrowings threatened to bring the operations of this bank to a standstill, and the Government, therefore, agreed to guarantee the repayment of money lent to the Sugar Bank for advances on the 1922-23 sugar crop. Three-year debentures bearing interest at 6 per cent. will be issued in repayment of the amount of the bank's indebtedness at the end of the crop. In Trinidad agricultural relief took two forms, namely, a temporary moratorium on mortgages and advances to planters by the Government, who market the resulting crops. In order to encourage adequate cultivation at this difficult period the Government of Grenada are distributing fertilizers to planters on a deferred payment system."

The Sugar Trade during 1922.

William Connal & Co.'s Annual Review.[1]

The year.—The sugar market opened in January with a depressed tone. All restrictions on the free sale of Cuban sugars had been removed, but the carry over of 1,250,000 tons of the old crop, to be added to that of the new just commencing, and then estimated at 3,500,000 tons, weighed heavily on the market, and caused 10s. 6d., c.i.f., to be accepted for Cuban sugars—a price suggestive of pre-war values. During January the market was slightly relieved by the purchase of 250,000 tons of old crop sugar by an American syndicate to be "tolled" for export —a venture which proved highly profitable. Sales at 10s. 6d., c.i.f., were of short duration; it was a price under the cost of production, which made the American market, for the time being, the cheapest in the world. Such being the case, buyers appeared from all quarters, not only from America and Canada, but from Europe, and the Far East—China, Japan, Australia—all anxious to have their depleted stocks cheaply replenished. This led to an active market, and to an advance during January of 1s. per cwt., the quotation at its close being 11s. 6d., c.i.f.

An active market continued during February, and the quotation was then further advanced to 11s. 10½d., c.i.f. During this month quite a remarkable sale of 5000 tons American granulated was made to Hong Kong.

The statistical position was improved during March by the record exports from Cuba which had been made during the first eleven weeks of the year—namely, 1,658,000 tons. This caused a great decrease of the Cuban stocks, which had thereby been reduced to 1,314,000 tons of both old and new sugars. A feeling of confidence was thereby imparted to the market, which enabled sellers to raise their limit to 13s. 6d., c.i.f.

During April the reaping of the Cuban crop made satisfactory progress, and as the canes proved abnormally rich in saccharose, it became evident that the previous estimate of 3,500,000 tons was likely to be exceeded, and it was considered that 3,700,000 tons was likely to be attained. A large business continued to be done during the month at steady prices. Several centrals, which had been silent during the early months of the crop, on account of the ruinous prices then ruling, were encouraged to resume work, now that prospects had become more favourable, and with their addition the crop was being reaped by 198 centrals.

May saw a continuance of a large daily business, amounting occasionally to 100,000 tons per week, and at prices ranging from 13s. to 13s. 6d., c.i.f.

June opened quietly, but soon developed strength from an active refined market then experienced by American refiners—fruit crops were proving abundant, and consumption had so increased that it was with difficulty that its wants could be supplied. This led to large purchases of raw sugar, and notwithstanding Mr. Himely's increased estimate of the Cuban crop to 3,800,000 tons, quotations were advanced from 13s. 6d., early in the month, to 16s. 6d., c.i.f., at its close. Constantly decreasing Cuban stocks from active American demand, and large exports, drove the American market in July up to 19s. 3d., c.i.f., for Cuban sugars. At this advanced limit British refiners refused to follow the American market for Cuban sugar, as they found that their wants could be supplied on more favourable terms from other sources, and except for an occasional cargo taken by an English refiner, Cuban sugars ceased from July to be of further interest. The sugars which from July till the close of the year have supplied British refiners have been Java, Mauritius, Peru, Brazil, and B.P. West India, all of which have been obtainable,

[1] Abridged from the Review, published by Wm. Connal & Co., Victoria Buildings, Glasgow.

when wanted, at prices under those ruling in America for Cubas. Of these sugars Brazils have more recently come into favour as centrifugals, and have become known as being of good refining quality.

Cuba.—As stocks of the late Cuban crop were almost exhausted previous to new crop becoming available, the American market for these sugars was advanced to 4 cents, cost and freight, New York, the equivalent of 20s. 3d., c.i.f., for the United Kingdom, but at this advanced price some remnants of Cubas, warehoused in Liverpool and Clyde, were shipped to America, where this full price was obtained, instead of 17s. 9d., c.i.f., the value at time of shipment. The outturn of the Cuban crop just finished has been 3,996,387 tons, being the largest crop the island has ever produced. The crop, the grinding of which has now commenced, gives promise of being quite equal, if not greater, and is at present estimated by Mr. GUMA as 4,193,000 tons, and by Mr. HIMELY as 4,103,000 tons. There are now 46 centrals at work, and there is an evident desire to make rapid progress in grinding that advantage may be taken of the present favourable market.

Some sales have been reported of new crop Cubans—for the Continent about 17s. 3d., and for the United Kingdom about 17s. 1½d. to 17s. for early February shipment, at which prices there are now no sellers.

It is interesting to learn from the report of the Cuba Cane Corporation, reported in *Facts about Sugar*, that the cost per lb. of production of their entire crop was 1·945 cents per lb., f.o.b., equal to 9s. per cwt., and the average selling price was 2·24, or 10s. 3d. per cwt.; and at present ruling prices such a result should give Cuba increased financial assistance.

American domestic.—The American Agricultural and Colonial interests who pay no duty on their sugars, but who have the privilege of selling them at a duty-paid price—at the Cuban duty of 7s. 4d. per cwt.—have recently agitated for an increase of this bounty, on the plea of its being insufficient to meet the cost of production. They have succeeded in getting the Cuban duty raised to 1·76 or 8s. 1d. per cwt., instead of 7s. 4d., giving them an additional bounty of 9d. per cwt. They have also succeeded in getting their protection, against outside buyers, raised from 9s. 2d. to 10s. 1d. per cwt. This bounty seems very extravagant in comparison with the preference of 3s. 6d. to 4s. 3d. per cwt. enjoyed by sugars grown in British possessions. Notwithstanding this large bounty, American Colonial cane sugars—namely, those of Louisiana, Texas, Porto Rico, Hawaiian, Virgin and Philippine Islands, not only show no increase, but a decrease of 89,500 tons during the past year.

British sugars.—The West India Crown Colonies which enjoy a preference of from 3s. 6d. to 4s. 3d. per cwt., having made no increase in production during the year, having only produced 265,000 tons against 265,478 tons last year. They have, however, made marked improvement in the quality of their output. Several Trinidad planters having found that yellow crystals no longer enjoy their former ready sale, have adapted their machinery to the manufacture of a white sugar, which has met with acceptance in the British markets, as being most suitable for manufacturing purposes. There has now been established in Trinidad a scientific experimental station for the thorough consideration of all matters concerning the cultivation of canes, and the manufacture of sugar. This station should benefit all the adjacent islands by its investigations. Barbados continues to enjoy a reputation for the excellent quality of its molasses, which find a ready sale in both the American and Canadian markets. Its centrifugal sugars also meet with a ready sale in all markets. Some of its estates which realized fabulous prices during the war have lately changed hands at a much reduced value. Some Jamaican estates

have likewise succeeded in the manufacture of a white sugar which meets with a ready sale in the island, and for which a good price is paid. It is in high favour with the Chinese merchants and shopkeepers. The other West India islands and Demerara have also the manufacture of white sugar in view, as being now a matter of necessity. When the labour question has been satisfactorily settled for Demerara, an increase in output may be confidently expected there. Mauritius, Australia, and Natal show a moderate increase of 25,000 tons during the year. The fine quality of Mauritius sugar has been much appreciated, and large imports of this sugar have been taken by British refiners during the last half-year.

United States beetroot crops.—These have been deeply disappointing during the past year, and are only yielding 625,000 tons against the previous crop of 911,000 tons. Notwithstanding the bounty they have enjoyed during past seasons of 7s. 4d. per cwt., they have never shown the extension that might have been expected, nor have they ever succeeded in obtaining much more than about one ton of sugar per acre.

Continental beetroot crops.—These have shown an increase during the past year of 768,000 tons, and now amount to 4,755,500 tons against 3,987,600 tons in 1921. The *Journal des Fabricants de Sucre* reports that good progress is being made with these crops. Those of Germany may quite realize 1,600,000 tons, if not more. France where the quality is superior and the weights good, may exceed 560,000 tons, and Czecho-Slovakia by producing 750,000 tons will have about 400,000 available for export. The other countries are expected to produce their estimated quantities. The pre-war Continental crops were 8,435,000 tons.

The consumption of the United Kingdom, based on the November Board of Trade returns, is estimated at 1,578,000 tons, against 1,420,000 tons last year. A greater increase could not well be expected, so long as the duty remains at 2¾d. per lb., and when unemployment has greatly reduced the spending powers of the masses.

American consumption, which was last year, according to WILLETT & GRAY, 4,107,328 tons, is known to have considerably increased during the year. The meltings through all the ports have been 4,142,000 tons, and to these must be added the sugar which has gone into direct consumption. The total consumption of the year may, therefore, probably approximate 4,500,000 tons.

The following table will give an idea of the total consumption of Great Britain during the past three years:—

	1922. TONS.	1921. TONS.	1920. TONS.
Meltings of raw sugar in London, Liverpool, and Greenock	1,000,000	950,000	937,325
Probable consumption of Foreign refined	578,000	470,000	340,000
	1,578,000	1,420,000	1,377,325

World's beet and cane.—The world's supplies of beet and cane together with stocks carried over at 31st August, stand approximately as follows:—

	1922-23. TONS.	1921-22. TONS.	1920-21. TONS.	1919-20. TONS.
Stock in Statistical Countries carried over on 31st August	1,500,000	2,000,000	1,500,000*	1,000,000*
European beetroot crops	4,735,500	4,054,282	3,671,788	2,594,166
American	640,000	930,121	1,004,019	669,457
Cane crops	12,691,500	12,679,948	12,081,831	11,904,586
	19,567,000	19,664,351	18,257,638	16,168,209

The following table is intended to show how much of these supplies have been consumed during the past three years, and will enable a rough idea to be formed

* Estimate, in absence of reliable Continental statistics.

of the relative position of the World's supply and demand till the end of the sugar year on 31st August, 1923:—

	1922-23. TONS.	1921-22. TONS.	1920-21. TONS.	1919-20. TONS.
Visible supplies on 31st August, 1922, 1921, and 1920	1,500,000* ..	2,000,000* ..	1,500,000* ..	1,000,000*
Production of beet and cane..	18,067,000 ..	17,664,351 ..	16,757,638 ..	15,168,209
	19,567,000	19,664,351	18,257,638	16,168,209
Deduct visible supplies on 31st August, 1922, 1921, and 1920..	— ..	1,500,000 ..	2,000,000 ..	1,500,000
Total consumption for year ending 31st August	—	18,164,351	16,257,638	14,668,209

Greenock refined.—The five Greenock refineries have maintained a fairly steady output for most of the year. Meltings show an increase of 53,423 tons over those of 1921. There were reductions in February from shortage of raws. and in December from the poor demand for refined. On 2nd January the price of Greenock fine granulated was 45s., and within a week it had fallen to 44s. 6d., but an improvement set in, and in the third week of January 45s. 3d. was paid, which improvement made further progress, and at the end of the month up to 46s. 9d. had been paid. In February easier prices ruled, and at the end the quotation was 45s. 9d. There were firmer markets in March, which closed with the quotation about 48s. April shows a decline of 6d., and in May there was a further decline of 6d., but the market improved towards the end of the month, when 47s. 9d. was quoted. In June the market was firm, and an advance made of 1s. 6d. to 49s. 3d., the advance continuing during July and the first half of August, when 52s. 3d. was paid, the highest figure of the year. A reaction set in then, and by the end of August the price had dropped to 50s. 6d. The fall continued, and at the end of September 48s. was the quotation. There was a good demand in October, with prices up to 49s. 9d. at the close. During November and December prices were steady, and 49s. 3d. is the value at the close of the year. Greenock refiners have been able to dispose of considerable quantities of their sugars in London and the South of England throughout the year, but the Irish demand has suffered from the political troubles there. Germany took a fair quantity in May, but it is hardly likely this will occur again, as Germany should now produce sufficient for its wants. For the past few weeks the Greenock supply has been greater than the demand, and the melt had consequently to be reduced.

American refined.—At the beginning of the year American granulated was being sold at 18s., c.i.f., for arrived, and at 17s. 1½d. for January/March shipments. The price advanced to 19s. at the end of January, at which there were sellers from second hands, but New York was asking 6d. to 9d. more. A decline to 18s. 3d. followed in February, but before the end of that month prices improved, and the improvement continued till 21s. was reached early in April. In May the price fell to 20s., but by June there was an advance to 23s., and by July to 24s. 9d. Early in August the quotation had reached 25s. 9d. for September shipment, which price was the highest point touched. At this time considerable quantities were re-sold to America, as prices there were much above our parity, and this condition has prevailed almost to the end of the year. About the middle of December sales were made from 22s. 9d. to 23s., c.i.f., for February/March shipment. At the end 24s. was asked by New York refiners for this delivery.

* Estimate, in absence of reliable Continental statistics.

The German Sugar Production.

Difficulties over Financing Operations.

By our Continental Correspondent.

In the month of September, 1922, the German Government was obliged once more to regulate the traffic in refined and consequently also in raw sugar in order to distribute the sugar supply evenly, both among the inhabitants for their common use and among the industries using sugar as a raw material for their trade.

The general trend of the regulations is that all sugar factories are obliged to hand over the disposition of their entire output to an official commission, which distributes the raw sugar among the refineries, and the white sugar from those establishments and from the raw sugar factories turning out consumption sugar, among the consumers.

The commission puts at the disposal of the general and local authorities white sugar to the amount of one kg. per head of the population per month. The Secretary of Agriculture and Industry regulates the distribution of the balance over the industries using sugar, and supplies in the first place the jam, artificial honey, and similar industries that make substitutes for butter. Until further notice, the use of sugar in the manufacture of chocolate, sugar candy, spirit, and sparkling wines is prohibited; traffic in beets, pulp and molasses in the interior of the country is not submitted to regulations; but importation and exportation of sugar, beets and molasses require authorization by the commission. The basic price for the white sugar for the different uses will be fixed and repeatedly revised by the commision. Incidentally, the price for the sugar serves also for the calculation of the price to be paid for the beets.

At the moment of the promulgation of these decisions the price for the sugar still remaining from the old crop was fixed at 5000 marks per 50 kg., while that for the new crop sugar was to be calculated subsequently, after which the price of the beets for the 1922-23 crop could be fixed.

During October the payment for beets was regulated as follows: For every 50 kg. of roots delivered, the grower receives 175 marks within a fortnight after delivery, 60 marks on 15th March, 1923, and the balance, the value of which will depend upon the sugar price to be fixed in the course of the 1922-23 campaign, on later dates. Five-sevenths of that amount will be due on 1st May, one-seventh on 1st June, and the last one-seventh on the 31st July, 1923. If the price of sugar goes up after the 1st May next, the surplus eventually to be paid will become due after that date.

This scheme had not yet been in force quite a month, when already general discontent was experienced throughout the whole beet cultivating and sugar producing community. The sugar has to be distributed evenly during the entire year, but is produced during the months between September and December. This means that the sugar factories are obliged to keep their production unsold in the warehouses till the time comes for them to be called on to transport the raw sugar to the refineries. The stocks accumulate therefore in the hands of the producers, who cannot sell them nor can they obtain the money with which to pay for the beets or to give advances for the new crop. The beet growers are paid but an instalment in cash for the beets already delivered and receive the balance in stages much later on, the last one being paid more than a year after

they have sown the seed. On the other hand these growers have had to pay their land rents, pay for fertilizers, labour, etc., all in advance, and therefore they will have to spend money for the growing of the 1923-24 crop, at a time when the returns from the 1922-23 one are to an appreciable extent still unpaid. A representative body of beet growers therefore sent a petition to the German Government, in which they insisted on payment before the 15th December, 1922, of at least 400 marks per 50 kg. of beets delivered for the 1922-23 crop, instead of the 175 marks stipulated in the regulations. If that amount be not forthcoming they do not see the possibility of preparing and sowing land for the 1923-24 crop of beets. This will not only endanger the German sugar production and supply, but also the production of cereals, as the very useful rotation of beets and grains will be interfered with. They emphasized their request for a larger sum to be paid as a first instalment by mentioning that the price of beets which in October still could be assumed as 400 to 450 marks per 50 kg., had increased to at least 1000 marks by December.

A Government credit of 20 milliard marks has been discussed, which might be used as an advance to the sugar factories against security of their sugar in order to enable them to pay the beet growers, but enormous as this sum looks, it would mean only 100 marks for every 50 kg. of beets, since the German beet crop is estimated at 9,879,350 metric tons or slightly under 200 million "zentner" of 50 kg.

Another scheme is the exportation of 40,000 tons of sugar, which at the world's price will fetch 40,000 to 45,000 marks per 50 kg., and in that way would bring in a net sum of 32 to 36 milliard marks, or about double the amount of the proposed credit.

The advocates of this latter scheme point out that instead of the danger foreseen during summer that the industries, using sugar, might buy up all available sugar at tremendous prices, leaving the households and other consumers at the mercy of petty speculators, there actually exists a marked surplus. The sugar distribution has not been able to prevent the raising of sugar prices; in fact this article has become quite prohibitive for a great part of the people and even well-to-do consumers only use it sparingly. Out of the 350,000 tons of white sugar put at the disposal of the public by the commission during the first three months of the campaign, viz., the months of September, October and November, 130,000 tons have been sold at 6000 marks per 50 kg., 75,000 tons at 12,000, 50,000 tons at 15,000 marks, while for the balance of 95,000 tons prices of 20,000 to 24,000 marks were foreseen. The price for January, 1923, has been fixed at 20,000 marks per 50 kg.

It is thus evident that the general public cannot afford to pay such prices, so that out of the 140,000 tons given free during November no more than 70,000 to 80,000 tons have really gone over into the consumption.

Under such circumstances when consumption is greatly decreased and a crop of about 1,500,000 tons has been produced, an exportation of some 50,000 tons would relieve the holders of a good portion of their burden, without giving rise to any sugar famine.

Increasing demands are being made for the abolition of the German sugar distribution, which has the disadvantage of being not only troublesome, but also very expensive owing to the cost of sugar cards, distributing bureaux, etc., this having in fact contributed towards raising the price to the consumer.

Progress in the Sugar Industry in India.

The Report of the Secretary, Sugar Bureau, for 1921-1922 is of unusual interest and is divided into three main sections, Agricultural, Commercial and Industrial. The *Agricultural* work consisted of (1) Arranging mill trials of new canes found by experiment to be satisfactory as field crops, and to determine whether the higher sucrose content shown on chemical analysis in the laboratory is realized under crop conditions, and (2) The rapid multiplication of canes of proved superiority for distribution among large sugar cane growers. The agricultural tract, of which the soil at the Pusa Research Station where the varietal tests were carried out is fairly representative, at present contains nine modern factories in North Bihar, and the total area of cane grown in the neighbouring districts amounts to 128,700 acres. As a result of a series of experiments during previous years on the Pusa farm, a standard method of cultivation has been evolved. The cane varieties under trial were Java 36, Coimbatore Seedlings Nos. 210, 213, 214, 220, 221, 224, 225, 227, 228, 231, 232 and 233, grown side by side with the best local varieties, Hemja, Reora, Saretha, Maneria, Kuswar, Mungo, and Yuba. These 20 kinds were grown on 9·34 acres, and the average yield of canes was 574 maunds (of about 82 lbs.) valued at Rs. 287, while the total expenditure came to Rs. 191 per acre. The scale of manuring was purposely kept very low, as it was desired to test all these canes under conditions similar to those they are likely to meet with in the district.

The results of tests thus far carried out show that Coimbatore Seedlings 210, 213, 214 and 221 appear to possess qualities admirably suited to Bihar conditions. They are deep-rooting and therefore drought resistant and, what is even more important in this district, Nos. 213 and 214 are much earlier in ripening than the standard local variety, Hemja. This can be best shown by quoting the following Tables in full.

ANALYSES TAKEN ON THE 29TH NOVEMBER, 1921.

Description of samples.	Average weight of cane in lbs.	Juice per cent.	Brix.	In Juice Sucrose per cent.	In Juice Glucose per cent.	Purity per cent.
Co 213	1·640	62·42	15·37	12·14	1·57	78·99
Co 214	1·076	58·67	17·67	15·19	0·64	85·97
Hemja	1·174	55·15	12·26	9·16	1·22	74·68

ANALYSES TAKEN ON THE 16TH JANUARY, 1922.

Description of samples.	Average weight of cane in lbs.	Juice per cent.	Brix.	In Juice Sucrose per cent.	In Juice Glucose per cent.	Purity per cent.
Co 213	1·807	64·02	17·89	16·00	0·53	89·45
Co 214	1·250	59·68	19·45	17·13	0·30	88·08
Hemja	1·250	49 39	14·21	11·64	0·75	81·94

One of the chief desiderata of the Bihar sugar factories at the present moment is an early ripening cane with good tonnage, and this appears about to be realized in the near future. To produce the necessary amount of seed for the factories, a half acre plot was grown under irrigation, and, after six months' growth, cut up into sets and again planted, according to the Java plan. By this means 27 acres of seed cane were obtained within 12 months. A further step was taken in planting 25 acres of the four Coimbatore Seedlings mentioned above for a milling test under factory conditions. These canes came successfully through the trying hot season, were free from disease and of excellent growth. So impressed were the Bihar sugar planters by this plot, that they volunteered to defray the cost of a further 60 acres to be grown for seed purposes, in order that they might give the seedlings a further and extended trial. Besides the varieties enumerated above, several new seedlings were received from the Coimbatore

Cane-breeding Station during the year, and some of these appear to be better than any as yet grown, the Government being fully aware of the importance of keeping up a supply of new seedlings to insure the stability of the industry. Nine of the best Java cane varieties were also grown at the Coimbatore Station during the year, and multiplied as far as possible for trial in all the sugar cane experimental stations in tropical India. Of these, E K 2, E K 28, P O J 1410, and P O J 1497 appear to be thus far especially promising for Indian conditions as represented at Coimbatore.

Industrial.—The Bureau has continued to keep in touch with all the sugar factories in India, and returns were furnished by all of them for the working season 1921-1922. Special attention was devoted to the movements in sugar machinery, and the cost and equipment of the minimum sized factory ; and the Bureau was freely consulted by the Director of Industries in Bihar in the matter of a pioneer sugar factory, which it is proposed to start in South Bihar. Interest in sugar matters has been greatly stimulated because of the raising of the import duty on sugar from 15 to 25 per cent. *ad valorem.* But progress is likely to be slow at present because of the stringency of the money market, the high price of machinery and the difficulty of securing suitable blocks of unoccupied land where labour would be available at reasonable rates. Progress is none the less being made, as may be gathered from the fact that nine new joint stock companies for sugar manufacture were registered during the year. Also, as a result of profits made by existing factories during the war, most of them have taken the opportunity of considerably increasing their efficiency. The small 4-roller mill received from Hawaii during the year was found to work well with the Fordson tractor, dealing with Hemja and J 36 ; it was further arranged with the Bengal Government to test it with thick, soft canes at Dacca during the coming season. A register was opened for men seeking employment as works chemists and managers and agricultural superintendents, because of repeated enquiries for such officers.

Commercial.—Weekly statistical notes were continued in the *Indian Trade Journal* during the year, and these were so appreciated by subscribers that the Bureau was pressed to extend its activities and to arrange for a regular cable service regarding crop conditions and market reports from the principal sugar countries of the world. This was accordingly tried for six months at the expense of participating firms interested in sugar matters, and an extension for a further period of trial was unanimously recommended by the trade, and the Government of India sanctioned the proposal.

These evidences of usefulness of the Sugar Bureau are very gratifying, and it is obvious that it is a real live institution, frequently consulted by all sections of the industry. The library was considerably extended during the year, and a catalogue of books and periodicals will shortly be issued. A museum has been started with sets of samples of the various grades of sugar produced by each factory in India, renewable each year, and a collection of samples of gur from the chief sugar growing tracts in the country was added during the year.

C.A.B.

Advice has lately been given in American sugar circles to explain how expeditiously to open sugar bags. On one side of the seam there is a single thread while on the other side there is a chain of twine. This side bearing the heavy chain of twine is the proper side to attack when it is desired to open the bag. Cut the thread at the left hand side close to the cloth and pull both ends of the twine. The stitching will quickly unravel; and the bag is thus opened without the tedious job of cutting many stitches, and also without the possibility of damaging it.

The Control of Moth-borer in Cane Fields.

Moth-borer, in one form or another, is present wherever the sugar cane is grown, but there is, perhaps, a tendency in these days of Mosaic, white grub and root disease, to pay somewhat less attention to this pest than it deserves. The facts brought together in a recent study by G. N. WOLCOTT in Porto Rico[1] should therefore be considered carefully by all who are interested in getting the best returns of sugar from their fields. That it is a serious cause of loss is brought out very clearly by the author. While white grub (*Lachnosterna vandinei* and *portoricensis*), rhinoceros beetle (*Strategus titanus*), and root borer (*Diaprepes spengleri*) are much more obvious, the actual injury caused by them is usually restricted to definite localities. The moth-borer (*Diatraea saccharalis*) on the other hand is abundant in all parts of the island. The caterpillars bore into the young tissues, killing the apical buds, and also enter the stalks and make tunnels which retard growth, causing losses in weight and sugar, and sometimes stunting and even killing the canes. The losses have been estimated by the author (1917) at 900 lbs. of sugar per acre in the southern tract of Porto Rico, by VAN DINE (1912) at 870 lbs. in the eastern section of the island, and by HOLLOWAY (1919) at over 1000 lbs. in the Louisiana sugar plantations. The paper under reference brings together the knowledge gained as to the habits of the pest in Porto Rico and its preference for the different varieties grown, together with the effect on the borer produced by high and low rainfall and the burning of the trash after harvesting the canes.

The conclusions are mainly based upon an examination of 50,000 canes collected in all parts of the island during 1915 and 1916. Two main outstanding results are (1) that the infestation generally varies inversely with the rainfall, and (2) that, other things being equal, it is increased from 50 to 100 per cent. by burning the trash. While the exact influence of the rainfall has not been explained, the surprising result of burning the trash (often adopted as a measure against the borer) is traced to the fact that, while moths and pupæ and even grubs are not destroyed by this treatment, the invisible egg parasite (*Trichogamma minutum*), which is widely distributed, has no chance of escape and is practically wiped ont; and the comparatively few moth-borers left can very quickly multiply in its absence. This pest has the short life history of 25 days under favourable conditions, and in a twelve months' crop as many as ten generations may be safely gone through. The variety of cane appears to have a marked influence on the number of borers, but, for any definite conclusions to be drawn, the amount of rainfall and the burning of the trash must be taken into account. This complicates matters considerably, and a summary Table has been drawn up giving the number of fields examined, the varieties grown, whether the trash was burnt or not, the amount of rainfall whether above or below 50 inches, and the proportion of fields with one or two kinds of cane growing on them. The cane fields in Porto Rico are largely planted with a mixture of cane varieties, and where more than two were found in a field the result of the examination was discarded as introducing too great complications, while where only two were grown half of the damage is credited to each. The interpretation of the results is thus seen not to be easy, but the following have been extracted from the Table regarding the burning of trash and the rainfall.

[1] "The influence of the variety of sugar cane on the infestation by *Diatraea saccharalis*, and the other factors affecting the abundance of the moth-borer." G. N. WOLCOTT. *Journal of the Department of Agriculture and Labour*, Porto Rico. VI, 1, January, 1922.

The Control of Moth-borer in Cane Fields.

(1) *Burning the trash.*—Where the trash was burnt, with a rainfall under 50 ins. (146 fields), there was a 60 per cent. infestation, whereas with a rainfall over 50 ins. (68 fields), the infestation was 37 per cent. Where the trash was not burnt the figures were as follows:—rainfall under 50 ins. (47 fields) 46 per cent., and rainfall over 50 ins. (200 fields) 24 per cent.

(2) *Effect of rainfall.*—In the dry section (193 fields), where the trash was burnt the infestation was 60 per cent., and where it was not burnt 46 per cent. In the wet section (268 fields) the figures were respectively 37 and 24 per cent.

The number of fields under the different varieties differs considerably, and some kinds were only grown in the wet region while others were only found in the dry. Mixed fields are of less use also than those with only one kind of cane planted. The author concludes that a record of ten fields, in which the number of pure fields is not less than those with two kinds of cane, may be taken as giving data for a reasonable approach to accuracy. Working in this way he is able to draw certain conclusions with some degree of safety.

(1) Cristalina in dry and Yellow Caledonia in wet regions are only slightly affected by burning the trash, but Otaheite and Rayada in all comparable sections of the island are twice as much infested after such burning.

(2) The commonest canes, Otaheite, Rayada and Cristalina are about equally infested in burnt fields in the dry section (61, 62, 62 per cent.). B 3412 appears to be less attacked but, as it is a thin cane, there is probably not much difference in the infestation per ton of canes. This last cane, however, compares very favourably with D 117 and seedling canes from Demerara, Barbados and Porto Rico itself (Guanica).

(3) Rayada, under all other conditions than in (2), is less affected than Otaheite.

(4) Yellow Caledonia and Cavengerie, in spite of being long-season canes (18 months), show the least infestation in the moist section.

The moths cannot emerge from the chrysalids in the canes if these are covered with earth, but the buds of bored canes have been found to germinate as well as those attacked, therefore it is suggested that they should be planted in preference to their being left about. Burning such sets, as noted above, is not entirely efficacious. One of the greatest difficulties in Porto Rico is that fields newly planted are frequently surrounded by others in different stages of growth and thus liable to early infestation. The author suggests therefore a regulation of havesting where possible, so as to commence at a point furthest from the mill, cutting all fields in succession, and not planting up any fields till those around are free of canes. The practice of leaving on the field canes of inferior character is deprecated, as the most usual reason for their failure is the presence of moth-borer; such canes should be collected and crushed as soon as possible, as this is a very easy method of destroying all the borers still living in them. Cutting the canes low is of great use, as the borer always prefers the young parts to commence with, and stray shoots often appear if the stubble is left long. Fields around the collecting stations have been noted as always very heavily charged with masses of eggs on the leaves, and their location should be carefully considered.

In general, the author concludes that a very considerable reduction of moth-borer may be effected in Porto Rico through favouring the egg parasite by not burning the trash, by introducing the more resistant kinds (Yellow Caledonia, Cavengerie, and B 3412) wherever possible, care in burying all infected canes and generally in clearing up the fields and milling the canes left over as soon as possible.

While on this subject a note by K. KUNNIKANNAN[1] in Mysore has come to hand which may be of interest. In this he claims to have adopted a simple and effective method for controlling the moth-borer in this part of India. The method is certainly simple and there appears to be no reason why it should not be effective in reducing the moth-borer in quite young fields. In many localities in India the damage done to grown canes is not very serious but, where the borer attacks both the young shoots and maturing canes, keeping the young fields clear should have a marked effect throughout the season. Kunnikannan's method consists in trapping the moths which come to the cane field in small heaps of trash distributed among the young canes, this trash being, of course, absent in the newly planted fields. The moths, which are mostly nocturnal, hide in the heaps during the day and emerge at night to lay their eggs, and so can easily be collected and killed by one labourer who goes over all the heaps for the first two months after the shoots emerge. The experiment was worked out at the Babbur farm, and the infestation was reduced by it from the usual 40 to 50 per cent. to from 2 to 5, while at a place five miles away it worked out at 40 per cent. as usual. Several kinds of moths were found in the heaps, but the white moth, which is comparatively rare in South India, does not thus hide but is more or less lethargic during the day and can be at once seen and caught by hand on the bright green leaves. The author is engaged on perfecting his method by arranging that the moths, once entered, cannot leave the heaps, which will further simplify the working. He quotes the Imperial Entomologist as estimating the damage done by the sugar cane borers in India at Rs. 30,000,000 a year (£2,000,000), so that the matter is well worthy of investigation, and he promises a more detailed paper on the subject when his investigations have been completed.

C. A. B.

Air, Humidity, and Drying.

By P. H. PARR.

The principles involved in the drying of materials by the use of heated air are often imperfectly understood by many engineers, and the textbooks usually give but little definite information on the subject: moreover, the ordinary tables for air humidity, etc., have all been calculated to suit the requirements of the meteorologist, which differ from those of the engineer. This article offers a table of the properties of dry and saturated air, specially calculated by the author to suit the requirements of the engineer, and also shows the application of the table to a practical case of sugar drying.

The advantage of drying factory sugars to a low moisture content is gradually being better understood, and the reduction of sucrose losses during storage and transportation to destination is worth more than the cost of drying. For large crystals, which are to be marketed as such, and where brilliancy of appearance is a desideratum, the drying should be done in the centrifugal machines, by superheated steam, or heated air—for some purposes, paradoxical as it may appear, hot water is the most satisfactory drying agent—but for 96° and lower refining crystals, and for white sugars for pulverizing, the rotating dryer with hot air as the drying medium, is probably as satisfactory as anything, although the thermal efficiency is low.

The accompanying table gives the properties of dry, and of fully saturated air, which are of the greatest importance to engineers, for temperatures from 40

[1] *Journal of the Mysore Agricultural and Experimental Union*, IV., 3, 1922, p. 141.

to 100°F. In all cases, the figures refer to the presence of 1 lb. of dry air, so that, for example, at 60°F., the vapour weight being 0·011, the weight of the mixture of ·1 lb. air saturated with moisture is 1·011 lb. The methods of calculating the figures given in the table are somewhat more technical than it is convenient to detail in a short article. By U in the table and article is to be understood B. Th. U.

In this connexion, there are three definitions of importance, which are seldom enunciated with the clarity that is desirable. First: the "humidity" of air at a given temperature is the ratio of the moisture actually present to that which would be present if the air was saturated at that temperature; second: the "dew point" is the temperature at which air of the given moisture content would be saturated; and third: the "wet bulb" temperature is that at which saturated air would have the same total heat. The dew point is the natural basis of nearly all calculations, and partially saturated air is to be considered as saturated air at a lower—the dew point—temperature, heated up to the actual temperature. Further to elucidate these three points, suppose we have air at a temperature of 80°F., with a moisture content of 0·011 lb. per lb. of air. According to the table, 1 lb. of air, saturated at 80°F., contains 0·022 lb. of moisture, and so the humidity is 0·011/0·022 = 50 per cent.: the temperature at which air with a moisture content of 0·011 lb. is saturated, is 60°F., which is therefore the dew point: lastly, the total heat per lb. of air at 80°F., and dew point 60°F. is 19·3 + 0·247 (80 — 60) = 24·2 U., and the temperature of saturated air with this total heat is seen from the table to be just under 67°F., which is thus the temperature of the wet bulb thermometer for the initial air.

FOR 1 LB. OF DRY AIR: BAROMETER 30 IN. MERCURY.

Temp. °F.	Dry Air. Volume. Ft.³	Dry Air. Total Heat U.	Saturated Air. Vapour Weight. Lb.	Saturated Air. Volume. Ft.³	Saturated Air. Total Heat. U.	Saturated Air. Heating. U/°F.
40	12·5	1·9	0·0052	12·7	7·8	0·244
41	12·6	2·2	0·0055	12·7	8·2	0·244
42	12·6	2·4	0·0057	12·7	8·7	0·244
43	12·6	2·7	0·0059	12·8	9·2	0·244
44	12·6	2·9	0·0062	12·8	9·7	0·244
45	12·7	3·1	0·0064	12·8	10·2	0·245
46	12·7	3·4	0·0066	12·8	10·8	0·245
47	12·7	3·6	0·0069	12·9	11·3	0·245
48	12·7	3 9	0·0072	12·9	11·8	0·245
49	12·8	4·1	0·0074	12·9	12·4	0·245
50	12·8	4·3	0·0077	13·0	13·0	0·245
51	12·8	4·6	0·0080	13.0	13·5	0·245
52	12·8	4·8	0·0083	13·0	14·1	0·245
53	12·9	5·1	0·0086	13·1	14·7	0·246
54	12·9	5·3	0·0089	13·1	15·3	0·246
55	12·9	5·6	0·0092	13·1	16·0	0·246
56	12·9	5·8	0·0095	13·1	16·6	0·246
57	13·0	6·0	0·0098	13·2	17·3	0·246
58	13·0	6·3	0.0102	13·2	17·9	0·246
59	13·0	6·5	0·0105	13·2	18·6	0·246
60	13·0	6·8	0·0109	13·3	19·3	0·247
61	13·1	7·0	0·0113	13·3	20·0	0·247
62	13·1	7·2	0·0117	13·3	20·7	0·247

	DRY AIR.		SATURATED AIR.			
Temp °F.	Volume. Ft.³	Total Heat. U.	Vapour Weight. Lb.	Volume. Ft.³	Total Heat. U.	Heatings. U/°F.
63	13·1	7·5	0·0121	13·4	21·5	0·247
64	13·1	7·7	0·0126	13·4	22·2	0·247
65	13·2	8·0	0·0130	13·4	23·0	0·247
66	13·2	8·2	0·0135	13·5	23·8	0·248
67	13·2	8·5	0·0139	13·5	24·6	0·248
68	13·2	8·7	0·0144	13·5	25·4	0·248
69	13·3	8·9	0·0150	13·6	26·3	0·248
70	13·3	9·2	0·0155	13·6	27·2	0·249
71	13·3	9·4	0·0160	13·7	28·0	0·249
72	13·3	9·7	0·0166	13·7	29·0	0·249
73	13·4	9·9	0·0172	13·7	29·9	0·249
74	13·4	10·1	0·0178	13·8	30·8	0·250
75	13·4	10·4	0·0184	13·8	31·8	0·250
76	13·4	10·6	0·0191	13·8	32·8	0·250
77	13·5	10·9	0·0198	13·9	33·8	0·250
78	13·5	11·1	0·0205	13·9	34·9	0·251
79	13·5	11·4	0·0212	14·0	36·0	0·251
80	13·5	11·6	0·0220	14·0	37·1	0·251
81	13·6	11·8	0·0227	14·0	38·2	0·252
82	13·6	12·1	0·0235	14·1	39·4	0·252
83	13·6	12·3	0·0244	14·1	40·5	0·253
84	13·6	12·6	0·0252	14·2	41·8	0·253
85	13·7	12·8	0·0261	14·2	43·0	0·253
86	13·7	13·0	0·0270	14·3	44·3	0·254
87	13·7	13·3	0·0279	14·3	45·6	0·254
88	13·7	13·5	0·0289	14·4	47·0	0·255
89	13·8	13·8	0·0299	14·4	48·4	0·255
90	13·8	14·0	0·0309	14·5	49·8	0·256
91	13·8	14·3	0·0319	14·5	51·2	0·256
92	13·8	14·5	0·0330	14·6	52·7	0·257
93	13·9	14·7	0·0341	14·6	54·3	0·257
94	13·9	15·0	0·0353	14·7	55·8	0·258
95	13·9	15·2	0·0364	14·7	57·5	0·258
96	13·9	15·5	0·0377	14·8	59·1	0·259
97	14·0	15·7	0·0389	14·8	60·8	0·259
98	14·0	16·0	0·0402	14·9	62·6	0·260
99	14·0	16·2	0·0415	15·0	64·4	0·261
100	14·0	16·4	0·0428	15·0	66·2	0·261

We will now consider the application of the table to a practical case of sugar drying, and will make the necessary calculations for a plain rotating cylindrical dryer, where the heat is supplied entirely by the heated air. The conditions assumed are as follows:—

Dryer :—4 ft. diam. × 15 ft. long = 190 sq. ft. surface.

Sugar :—2 tons per hour; initial moisture 2 per cent., to be dried to under 0·3 per cent.: sugar enters dryer at 80° F., and leaves at 120° F.

Air :—Originally at 80° F., and 65° F. dew point; heated to 180° F., and leaving dryer at 120° F.

We may first consider the radiation from the shell of the dryer, which may be taken at about 1·2 U. per sq. ft. per hour per 1°F. temperature difference. The mean temperature of the air in the dryer is 150° F. (the arithmetic mean of the entering and leaving temperatures is near enough for these cases), so that the radiation will be 1·2 (150—80) × 190 = 15,960 U./hr.

Then, for the sugar, we have, initially 4480 lbs., with 2 per cent., or 90 lb. moisture, and 4390 lb. solids. If we dry out 77 lb. moisture, there will be left the 4390 lb. solids, and 13 lb. (0·295 per cent.) moisture, or a total of 4403 lb.

Now, considering the heat given up by the heated air in cooling from 180°F. to 120°F., the heat radiated from the dryer shell, and that taken away by the dried sugar with its remaining moisture, may be considered as being lost, whilst the heat taken up by the evaporated moisture will remain in the moist air leaving the dryer. Taking the specific heat of the solids as 0·35, we can easily make the following analysis :—

		U./hr.
Lost heat.		
Radiation, as above		15,960
Heating solids	4390 × 0·35 × 40	61,460
,, left water	13 × 40	520
		77,940
Heat in evaporated moisture.		
Heating	77 × 40	3,080
Evaporating	77 × 970	74,690
		77,770

and we note that of the 77,940 + 77,770 = 155,710 U./hr. given up by the cooling of the entering air, the relative amount of heat lost is 77,940/155,710 = 0·500.

Having done this preliminary work, we may now turn to a consideration of the air, and since it has originally a temperature of 80°F., and a dew point of 65°F., a reference to the table shows that the humidity is 0·013/0·022 = 59 per cent., whilst the total heat at 80°F. is 23·0 + 0·247 × (80-65) = 26·7 U./lb. air. The wet bulb temperature will be 69°F., or a depression of 11°F., which is lower than the usual 12-15°F., but is found in the tropics. Similarly, the total heat at 120°F. is 36·6 U. and that at 180°F. is 51·4 U. per lb. air. To heat 1 lb. air with its moisture content from 80° F. to 180° F. will require 51·4—26·7 = 24·7 U., and on cooling to 120°F. there will be available 51·4—36·6 = 14·8 U./lb. air.

It has been shown that, of the heat given up by the heated air on cooling, 50 per cent. is lost, so that the moist air leaving the dryer will have a heat content of 51·4—14·8 × 0·5 = 44·0 U./lb. air. We cannot readily make a direct calculation for the quality of the leaving air, but we can easily calculate a small table of the total heat in moist air at 120° F. corresponding to various dew points, in the manner previously illustrated, when we find :—

Dew point.	U./lb. air at 120°F.
75°F	43·1
76	43·8
77	44·6

and thus the dew point for the required 44·0 U./lb. is 76°F. (neglecting decimals of a degree).

Referring again to the table, we now have the data that the initial air, with a dew point of 65°F., has a moisture content of 0·0130, whilst the leaving air, with a dew point of 76°F., has a moisture content of 0·0191, and therefore each lb.

of air takes up 0·0191 — 0·0130 = 0·0061 lb. of moisture. Since there are 77 lb. of moisture to be taken up per hour, the air required per minute will be 77/60 × 0·0061 = 210 lbs.

If the fan for the dryer is a pressure fan, blowing the cold air through the heater and dryer, it will have to deal with 210 lbs. of air per minute, at 80°F. and 65°F. dew point. The volume of this will evidently be 13·4 (80 + 460) / (65 + 460) = 13·8 cub. ft. per lb., so that the blower must handle 210 × 13·8 = 2900 cub. ft. of air per minute.

With reference to the air heater, it is of little use to try and calculate from first principles, and practically it is best to refer to the tables, based on test results, given in the data books—though these can only be obtained by responsible engineers—of Sturtevant, the Buffalo Forge, or the American Blower Co.

Referring to the data book on "Fan Engineering" of the Buffalo Forge, and allowing for a steam pressure of 40 lbs. per sq. in. in the heater, it will be found that five 4-tube sections of No. 1 A standard heater should be satisfactory, with a total heating surface of 275 sq. ft., and requiring about 0·2 in. water pressure for the friction of the air. If we double this, to allow for the other air resistances, we need a blower to deliver 2900 cub. ft. of air per minute against a static pressure of 0·4 in. water; and for this duty, a Buffalo No. 4 Conoidal Fan will be satisfactory, and will require about ⅜ b.h.p. for driving. Very similar results will be obtained by referring to the data books of the other fan companies, and we may say that there will be required a heater surface of 250–300 sq. ft., and a fan to deliver about 3000 cub. ft. of air per min., at a total pressure of ½ in. water, and requiring about ½ h.p. to drive.

It has previously been shown that each lb. of air at 80°F., requires 24·7 U. to heat it to 180°F., and therefore there will be required 24·7 × 210 = 5200 U./min. for heating the air. Steam at 40 lb. per sq. in. has a latent heat of 919 U./lb., and allowing 5 per cent. loss, there will be required 5200 × 60 / 919 × 0·95 = 360 lbs. per hour of steam for heating the air. Allowing 1½ h.p. for rotating the dryer, and ½ h.p. for the fan, at say 60 lb. steam per h.p.-hour., the steam for power will be 120 lbs. per hour, making a total for the dryer of 480 lbs./hour, to evaporate 77 lbs. moisture from the sugar. Roughly, this means that to evaporate 1 lb. of moisture from the sugar requires the expenditure of 60–70 lbs. of boiler steam, so that the efficiency is very low indeed. At the same time, the total amount of steam required is comparatively small, and the beneficial results of drying the sugar, especially with the lower grades, are so great that usually it is well worth while to instal a dryer, the reduced loss of sucrose between factory and refinery, due to bacteriological and other causes, more than repaying for the expenditure of a few lbs. of steam and the machinery costs. At the same time, for the highest grade products the author believes that the proper place to effect the drying is in the washing centrifugals.

"No one should be disheartened or confounded if the experiments which he tries do not answer his expectation. For though a successful experiment be more agreeable, yet an unsuccessful one is often times no less instructive. And it must ever be kept in mind (as I am continually urging) that experiments of Light are even more to be sought after than experiments of Fruit." These lines written by the great LORD BACON were recently quoted by Dr. EDWIN E. SLOSSON, the American author,[1] who added in effect that this precept, that experiments leading to enlightenment on fundamental principles should be as much encouraged as those that immediately bring practical results, needs more than ever to be kept in mind to-day when employers are impatient of research that does not bring immediate and profitable returns.

[1] *Science Service*, September 16th, 1922.

Use of Revolving Cane Knives in Modern Milling Installations.

By J. H. PENNING, M.Am.Soc.M.E.

The use of revolving cane knives in cane sugar factories is very old; and, like many appliances in the Industry, after having been discarded in nearly all countries, is again being applied, and very successfully, especially in Honolulu and the Philippine Islands.

HISTORICAL DEVELOPMENT.

The revolving cane knife, of the type used in the olden days in Java, as shown in old catalogues of British sugar machinery manufacturers and in the old volumes of the *Archief voor de Java Suikerindustrie*, consisted of a series of curved knife blades bolted to cast iron bosses, and keyed to a round shaft, revolved at a comparatively slow speed over the carrier.

They were originally installed in Java to save the labour of cutting the cane leaf straps, with which the cane brought from the field was tied in bundles. It was, however, found necessary to keep a labourer on the carrier above the knives, to cut those straps which had been missed by the knives. Gradually the few sets which had been installed were scrapped.

In recent years the method of mechanical unloading of cane cars brought revolving knives again into use in Honolulu. When the mechanical unloaders were being used, the cane formed a tangle on the carrier, making it necessary to raise the sides of the carrier, a very uneven feed, with frequent choking resulting.

The first type of knives brought out was similar in appearance to the old Java knives, only very much more strongly built. They were run at a much higher speed, which was eventually raised above 300 r.p.m. Then the knives started to do useful work, but at the same time the strain told, and frequent breakages occurred.

The Meinecke knives, as used for some years, were in principle the same as the old revolving knives, but strengthened. The bosses were made of cast steel: the bolts holding the blades were made heavier: and, later on, when frequent shearing occurred, turned bolts were used in reamered holes.

Originally, the knives were used to cut down the tangled cane and improve the regularity of the mill feed; but it was found that by placing them nearer to the carrier slats, an excellent means of preparing the cane for the mill rollers, resulting in increased capacity at the mills, was thus provided.

The need for a stronger knife was then felt more than ever, and was filled by the invention of Mr. R. RENTON HIND, now the General Manager of the Pampanga Sugar Mills, Philippine Islands, and Editor of the *Sugar Central and Planters' News*, the leading sugar journal in the country named.

Mr. HIND called his device the "Hubless" knife, and the assembled set is shown in the accompanying cut.

The knife itself is a two-bladed, balanced implement with a hole in the centre of the shaft. Between the knives on the shaft are placed square cast-iron distance pieces, a feathering key securing blades and distance pieces to the shaft. Four through-going bolts placed round the shaft in the corners of the distance pieces, parallel with the shaft, pass through the distance pieces and the knives and pull the whole up against a fixed cast-iron flange, screwed on the shaft. Originally the knives were made of ½ in. boiler plate with a steel cutting edge welded on. The whole set is very rigid and well balanced, and many of these knives have been and are being installed.

As may be expected, however, the knives become blunt after some time, and not only do less work, but require an enormously increased power to drive them through the cane.

Knives, as now used in Honolulu and the Philippine Islands are of two kinds (*a*) levelling and (*b*) cutting. As a rule, the levelling knives are placed at the beginning of the incline of the cane carrier, and after passing these, the carrier should show an even blanket of chopped cane; while the cutting knives are, as a rule, placed on the top of the carrier, just before the cane tumbles into the shoot to the first set of rolls.

The cutting knives are placed about 1½ in. from the cane carrier slats, the levelling knives from 3 in. to 5 in., according to the regularity of the cane and the capacity of the crushing plant. The knives revolve in the direction of the carrier, and are covered by big boxes, provided with splashboards at the entrance. The bearings are arranged to slide on rails in a horizontal plane, and can thus be brought nearer or farther away from the carrier incline.

As the knives should cut, not disintegrate, it is essential that they be sharp. As soon as one becomes blunt, it takes a greatly increased power to drive; and, instead of cutting through, it bruises the cane.

With a sharp knife, no juice is lost: with blunt knives the carrier becomes a mess. With the hubless type some engineers get over the difficulty by using a portable, electrically-driven grinder, and sometimes keep one complete set of knives as a spare, which set is installed as soon as a stop of any length is made, while the first set is being sharpened up.

In changing a set of knives the work involves taking down the protective hood, opening bearings and disconnecting couplings in case of motor drive, or belts in case of belt drive, thus taking considerable time. Several inventive engineers, therefore, to overcome these difficulties, tried to produce a quickly detachable device. The advantages of this are, principally, that every shift a couple of knives can be replaced by sharp knives, so that by going round regularly the apparatus will be as sharp as it can possibly be, it being necessary to have only a few loose blades instead of a complete set of knives and shaft.

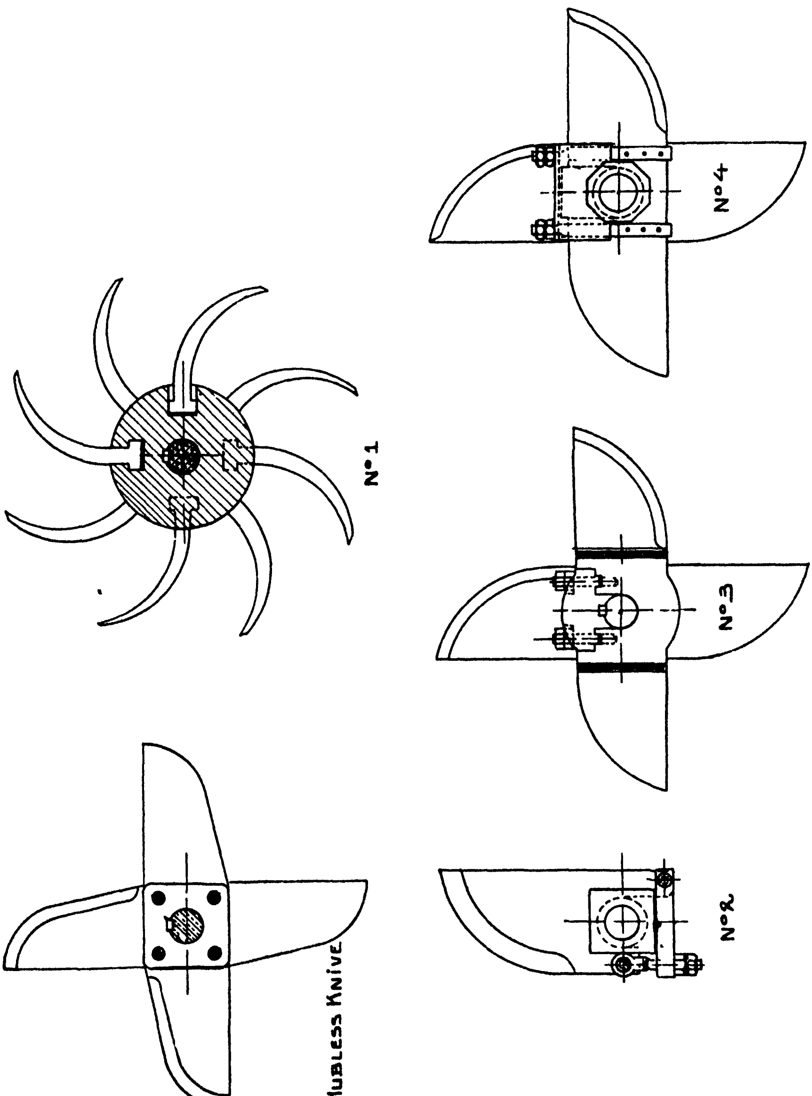
TYPES OF DETACHABLE KNIVES.

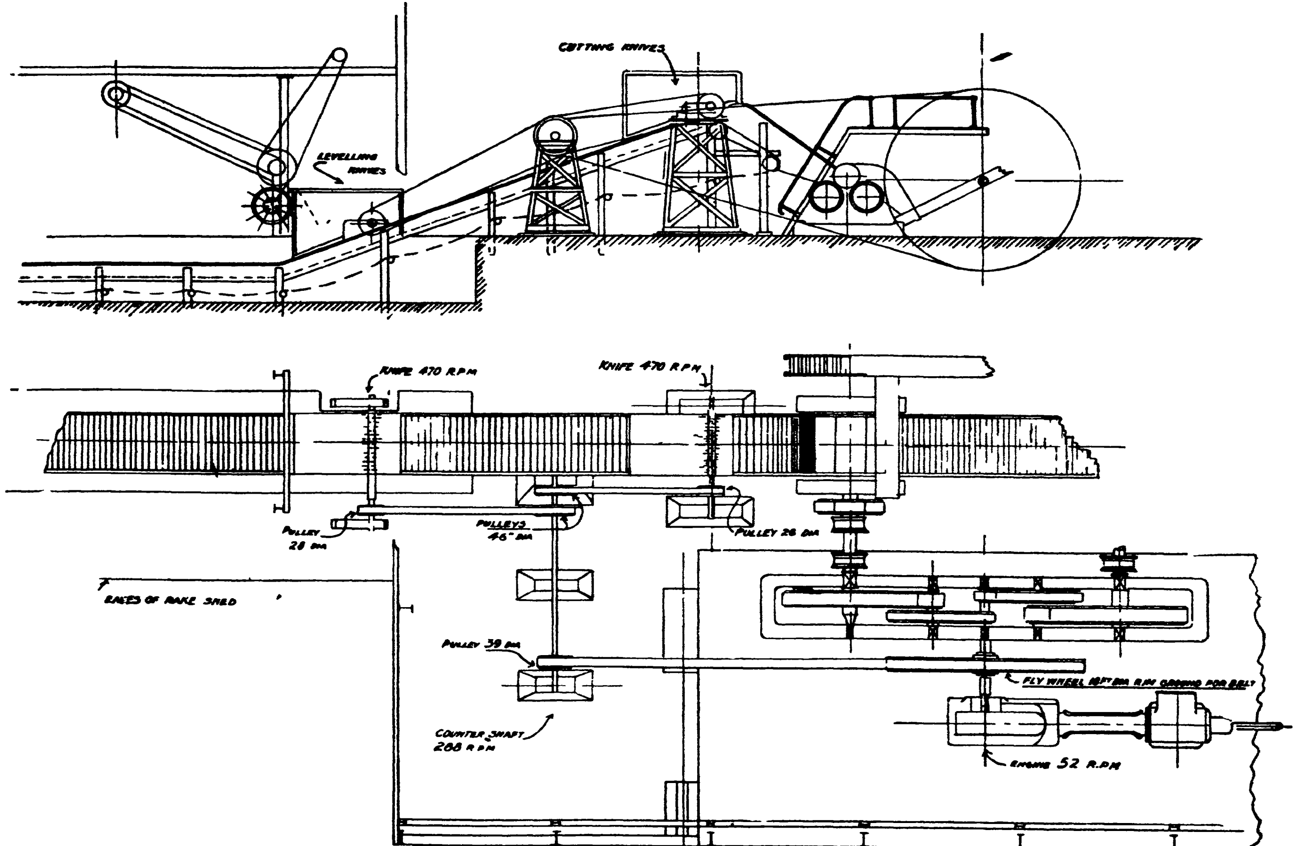
So far as the writer's knowledge goes, four detachable knives have been patented The first consists of a 15½ in. roller, made of cast-iron and fixed on a 4 in. shaft. In the circumference of the roller, dovetailed slots are cast in which the curved blades are slipped, the slot then being filled up with babbitt or lead. The slot and knives are so placed that each works in a separate cutting plane, and the knives chop the cane into a thousand pieces. But the knife is not readily detachable, as it is necessary to melt the lead or babbitt out with a blow lamp in order to replace a knife, and afterwards cast the new knife in place. Further, the set is rather costly. (No. 1.)

The second is a single-bladed knife, having a groove in the end, which fits in a slot cut in a square shaft. The blade is kept in place by a lock strip hinged at one side of the slot in the knife, and pulled up by a hinged bolt fixed to the knife blade on the other side of the slot. By undoing this bolt, the knife can be readily removed; but it is not balanced, and the pins securing the strip and bolt to the knife are subject to a shearing strain. (No. 2.)

The third is a double-bladed knife with a large hub divided in two by a dove-tailed joint. It is made in one piece with the hub, which is keyed to a round shaft. This knife is well balanced, but it would appear very costly in manufacture, as the machining has to be perfect. It would also appear that it might be difficult to detach this knife, after cane juice gets into the dove-tailed joint. (No. 3.)

The fourth is the most recent of the four, and consists of a knife-blade, like the hubless blade, but the centre hole is slotted to the side. The knife is placed in slots cut in the lathe in a hexagonal or square shaft and fixed by a plate steel saddle, drawing the knife immovable to the shaft by two hook-bolts passing alongside the knife. By removing bolt nuts, the knife is readily detachable. It seems very well balanced, and is cheap in manufacture. With this device it is an easy job to change a couple of knives during a five minutes' stop. (No. 4.)





INSTALLATION FOR DRIVING CANE KNIVES.

DRIVING CANE KNIFE INSTALLATIONS.

Cane knives are mostly driven by electro-motors, direct-connected to the shaft by a flexible coupling. In some factories in the Philippine Islands they are driven by belt direct from the mill engine fly-wheel. The Figure on page 24 shows the arrangement of this drive. In another instance, driving was effected by a separate high-speed steam engine and belt drive. The speed at which they should be run is between 400 and 500 r.p.m.

In Honolulu and the Philippine Islands most factories use slip-ring type A.C. motors, 60 cycle, 440 volts, which run at about 520 revs. per min., or slightly under 500 when fully loaded. Usually the levelling knives are spaced at 5 in. pitch, and the cutting knives at 2½ in. pitch.

For a 78 in. wide carrier, usually a 50 h.p. motor is used for the levelling, and a 75 or 100 h.p. motor for the cutting knives, according to the capacity of the crushing plant. For a 60 in. one the motor supplied for levelling is 40 h.p.

Naturally, the average power developed by these motors is far below their plate rating, but they are also subject to heavy overloads when a large bundle of cane is discharged into the carrier. Sometimes, when the blades become dull, the motor has been known to stop.

In most factories in the P.I., only levelling knives are used; but cutting knives have been proved to increase the output of a crushing plant considerably. The writer has no actual figures at his disposal. The new mills in the Philippine Islands with which he was acquainted were too busy taking off the crops to have any time for experiments, but it was conclusively shown to be impossible to work a mill without the levelling knives at anything like the output obtained with this installation. After the cane has passed the knives, the greatest tangle is straightened out, and an even blanket cut in short pieces shows on the carrier. In nearly all mills in the Philippine Islands, the Fulton type of grooved crusher having two or three rolls is used. The extraction obtained by them is even increased.

As said before, the writer has no data, but it is evident that with the use of levelling knives only, choking of the first rollers is practically unknown. The feed is regular and uniform, and it is safe to say that the use of the appliance under discussion increases the crushing capacity of a given plant by not less than 5 per cent. One central in the Philippine Islands, using the Cuban type of cane dumping with an auxiliary carrier feeding the carrier leading to the rolls, found it imperative to instal a set of levelling knives after one season's run, to eliminate the frequent choking at the crusher.

As compared with the shredder, two sets of knives will nearly do the same work, and at a very much lower initial cost and upkeep. Cane knives can be applied to any existing carrier without alterations of the general arrangement.

When cutting knives are used, it is advisable to provide steel overlapping slats, as wooden slats let a lot of fine chips fall through, making a mess in the carrier pit. However, the use of steel carrier slats, which can be ordinary flat steel plate strips, is always advisable when mechanical unloaders are being used.

Summarizing, the following are the advantages of the revolving cane knives:—(1) They produce an even and uniform feed to the rollers, thereby preventing chokes, and increasing the daily capacity of the crushing plant; and (2) they increase the extraction by preparing the cane for the rolls.

The following points must be observed when using them:—(*a*) The blades must be sharp; (*b*) They must run at a sufficiently high speed; and (*c*) Overlapping steel carrier slats should be installed if cutting knives on the carrier head are used in addition to the levelling knives situated on the horizontal portion of the cane carrier.

The Thomas and Petree Process in Hawaii.[1]

By S. S. PECK.

A very interesting development in the manufacture of sugar will be the installation of the Dorr clarifiers and operation of the Thomas and Petree Process at the factories of the Hawaiian Commercial and Sugar Company, and the Maui Agricultural Company for the 1923 crop. The Dorr clarifier has already been successfully applied, and the Thomas and Petree process is now being operated in about 40 factories in different countries, but this will be the first time it has been worked in Hawaii. Herewith, I submit a detailed description of the same; its expected advantages both from an operative and economical standpoint; and the general considerations which have led to its installation.

Description of Process.

In the usual factory operations, the juices from two mills are combined, tempered with lime, heated, run into settling tanks, the clear juice after sedimentation sent to the evaporators, and a sediment with about 12 to 25 per cent. of juice pumped into filter-presses. Here the mud is retained and its content of sucrose partly washed out with water, the recovery varying according to the quality of the cake and the amount of water used in sweetening-off, which may amount to as much as 5 tons of water per ton of cake. The press cake discharged contains from 1 to 5 per cent. of sucrose, and from 65 to 75 per cent. of water. The washing of the presses may continue for several hours, during which time there is a drop in the purity of the washings, increasing with the duration of washing, either a destruction of sucrose by inversion, or a re-solution of the impurities in the cake, or both these conditions being indicated. The former is reflected in a higher undetermined loss; and the latter in a greater amount of molasses and less recovered sugar.

By the adoption of the Dorr clarifier, which is a continuous type of settling tank, 95 per cent. of the liquid entering goes as clear juice to the evaporators, and only 5 per cent. leaves with the sediment. This type of apparatus has several distinct advantages over intermittent subsiding tanks or the present type of continuous settlers.

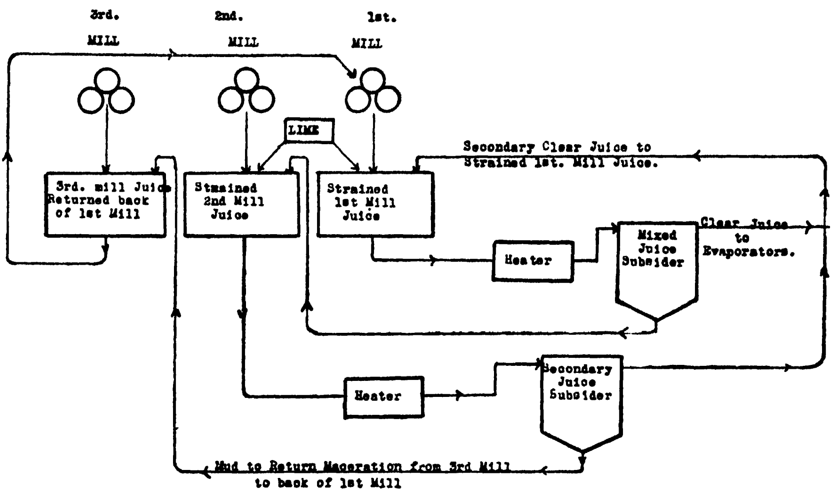
In the Thomas and Petree process, two changes are introduced, viz : apparatus and operation. In its operation, the juices from the first and second mills are limed, heated, and settled separately. The clear juice from the first mill goes directly to the evaporators, but its mud joins the limed second mill juice in its passage through a heater and a separate or secondary subsider. The juice from this joins the limed first mill juice in its passage through a heater and a subsider, and goes with it to the evaporators, the combination being exactly as in ordinary practice, with the difference that, whereas now the mixed juice consists of raw first and raw second mill juice, under the process conditions it is made up of raw first and clarified second mill juices. The sediment from the secondary subsider is run into the tank receiving the third mill juice, and is sent back with this as maceration behind the first mill. The flow of juices and mud is illustrated in the accompanying drawing. Modifications of this can be made to suit peculiar conditions, though the principle would remain the same.

[1] Report presented to the Committee on Manufacture of Sugar, Hawaiian Sugar Planters' Association, Honolulu, T.H.

Advantages and Theoretical Considerations.

As the process has not yet been demonstrated locally, it will be understood that its advantages must necessarily be regarded from the theoretical point of view.

Character of the mud.—Clarification in the presence of "cush-cush" results in a purity value lower than that obtained in its absence, more gums being present. A neutral or alkaline clarification is best. Most of the finer particles of cush-cush come from the second mill, and their solubility is a function of their fineness and of the reaction of the liquid, being more soluble in an alkaline medium. In the process, it is directed that the first clarification be made in neutral or alkaline condition, and the second at a slightly acid reaction, at a higher temperature than in the case of the first. Hence, the following favourable conditions are realized: The liquors going to the evaporators are alkaline; the juice containing the bulk of the cush-cush is clarified in an acid state; the returned mud from the first subsider is subjected to a higher temperature than that under which it was produced; and the combined mud is sent under these conditions to the mill. There should therefore be less solution of the insoluble matter; and, if there is any analogy between the action of decolorizing carbon and that of bagasse, a better fixation of the mud by the bagasse. It is this condition which the inventors of the process describe as "stabilized mud."



Clarification of the juices.—It has been definitely proved that the first mill juice clarifies better and more rapidly than the second. Excluding the suspended matter, there is about 30 per cent. more precipitable matter per unit volume of juice in the first than in the second juice. According to the Thomas and Petree process, the whole of the precipitate from the first juice is returned to the second juice, and assists in the subsidence of the precipitate formed in this juice, this being characterized by the inventors as the "drag-net" property of the first juice sediment. This effect may be due partly to the character, i.e., the density, of the first mud, but is also connected with the increased amount of enveloping particles in the sedimentation of the second juice. The juice from the Dorr clarifier is far freer from suspended matter than is the case with juices from intermittent settling tanks, and clearer than juices from the best types of continuous settlers now working in the Islands. This insures better working at all

stations subsequent to the clarifiers. The returned mud to the mill cannot get into the evaporators, because if by any mischance some mud does go through the bagasse blanket with the expressed juice, it can go only to the secondary subsider, whence it is again returned to the mill. With a full blanket this will not occur; though it may happen occasionally when there are interruptions to the feed of cane and when the returned mud supply is not shut off.

Liming.—The process includes an automatic liming apparatus, which presents distinct advantages over former methods of attempting continuous liming, in that the flow of lime is stopped and started along with the crushing of the cane. But the regulation of the amount of lime will necessarily have to be as carefully controlled as at present. Another benefit is that the lime is put into the juice within a very brief time from its expression from the cane.

Amount of juice in mud.—Under the present conditions of settling, from 10 to 25 per cent. of juice accompanies the mud in its travel to re-settling tanks or presses; whereas in the Dorr, the amount of mud removed is controlled by a diaphragm pump, in such a manner that only 5 per cent. of juice is taken with it.

Effect on rolls.—With continuous sedimentation, and continuous withdrawal of mud from the clarifiers, there is a steady flow of mud to the mills. On an average, to each 100 tons of cane passing through the mill, there will be returned 2·5 tons of wet or 0·75 ton of dry mud, which is made up largely of fine cush-cush. It is safe to say that this constituent comprises over 60 per cent. of the total dry mud, so that in reality, only 0·3 ton of dry matter other than cane is added per 100 tons of cane. This is so well distributed, and so ready for absorption by the bagasse, that it is hard to see how any effect on the rolls can be feared. Where attempts have been made to return mud under ordinary conditions, the interference with roller work has been due more to the diffused condition of the mud, and the large amount of juice returned into process.

Effect on extraction.—In the advertising matter of the Thomas and Petree Company, instances are given where, following the adoption of the process, there has been an actual increase in the sucrose extracted. The data given are not sufficient for a close comparison, there being decided variations in the quality of the cane, bagasse, and amount of maceration water. For the purpose of a closer estimate of what effect the return of juice would have on extraction, the writer has made a series of calculations, adopting as bases the following: A cane with 13·5 per cent. polarization, and 10 per cent. fibre; 40 per cent. water added on cane; juice extraction at four mills, 66·7, 70, 77, and 84 per cent. respectively; admixture of added water or returned juices, 40, 50 and 60 per cent. efficiencies at second, third and fourth mills, respectively. The usual method would give finally an extraction of 98·11 per cent. Returning 20 per cent. of mixed juice in front of the second mill reduced the extraction to 97·53 per cent., or 0·6 per cent. less; returning 5 per cent. of the second mill juice reduced the extraction to 98·05 per cent., or 0·06 per cent. less. There is nothing more positive about these figures than that with a return of 20 per cent. mixed juice to the cane, an important drop in extraction will result; and that with a return of 5 per cent. of the second mill juice, a very slight drop in extraction will follow.

Effect on clarification.—If no mud returns through the bagasse blanket into process, the effect on clarification should be nil. The Dorr clarifiers appear to give a much more brilliant juice, but data on an increase in purity are lacking. There is much less suspended matter, and there would probably be no need for subsequent filtering or straining of the clarified juice. Due to the return of juice with mud, there will be about 2·5 per cent. more juice settling capacity required. A similar calculation on the return of 20 per cent. juice with the mud

shows that 25 per cent. more settling tank capacity will be required for the extra amount of juice handled at this station; and with poorly settling juice or an occasional return of mud into process, this percentage will be increased.

Effect on boiling, etc.—The delivery of a clear juice to the evaporators will automatically make for easier operation from this place on. It has been stated that in a Cuban factory where the Dorr clarifier was installed without any other change, the syrups boiled more easily, the sugars dried more rapidly, and that an increased polarization in the sugar resulted with less washing than previously. Where the Thomas and Petree process was introduced, no interference with ease of boiling followed; when plantation whites were produced, there was apparently less trouble in turning out a sugar of good colour.

Effect on fuel.—Although not anticipated, it was found that after the mud was returned, there was an almost complete disappearance of clinker in the furnaces, the ash being free and friable.

Effect on undetermined losses.—In every case, the process has reduced these losses to an important extent. It is believed that a large part of this benefit is due to the fact that the juice is in process a shorter time, and that there is not the danger of considerable losses at the press station, due to time of filling and washing, in addition to possible losses where juices are re-settled and sediments blown up with steam, with or without lime. A very approximate calculation gives that when there is a drop of two points between the purities of mixed and press juices, there is a loss of 0·47 per cent. of sucrose in cane; and where the difference is five points, the loss is 1·18 per cent. These losses would be recorded as undetermined losses. In a Dorr clarifier there is about 50 per cent. less juice in process, and there being no filter-presses, blow-ups, or long continued washing of cake, there is every reason to believe that where undetermined losses occur, they will be reduced to a minimum.

Fuel economy.—This is indicated in various ways. There is more fuel for the boilers, corresponding to the amount of cake returned to the mill, and referred to the same moisture content of the bagasse. There is fuel saved, corresponding to the amount of water now used in sweetening-off cake, which must be evaporated. Furthermore, there is heat saved due to losses by radiation in the present type of settling tanks, in steam used in blow-ups, and in radiation and heat losses at the filter-press station, and there is also steam saved, corresponding to the number of small pumps now used over and above that required in the process.

Labour saved.—Naturally, all the labour now required at the filter-press station will be dispensed with in the process. In addition to this, there will be a reduction in labour when the ordinary settling tanks are replaced by Dorrs. After these are once adjusted, they require only a very occasional inspection, a duty which can be performed by the man at the heaters or even at the scales.

Material saved.—Filter-press cloth expenses, and costs of replacing filter-press parts or repairing mud pumps, etc., are also of course obviated, as will also the maintenance expense of mud cars, and the cost of hauling and distributing the press cake to the fields.

FINANCIAL ADVANTAGES.

A calculation of the economy which may be due to the process must of necessity be purely speculative. But accepting the above statements *in toto*, the various savings which would then result would be the following:—

In the case of a factory grinding 200,000 tons of cane and producing 25,000 tons of sugar, allow that there are 5000 tons of press cake produced, of 2 per cent. sugar, 70 per cent. moisture; that the bagasse contains 40 per cent. moisture and 1·5 per cent. sugar; that the labour at the filter presses costs 15 cents per ton of

crop can use the fertilizer, but the conclusion seems reasonable that the cake does not supply fertilizing elements as such, or in a very slowly available form. It is therefore reasonable to believe that the effect of the cake is due to components other than the fertilizing elements, and these are principally fibre and sugars.

Under good conditions, the fibre will form humus, and as such add very materially to the fertility of the soil. An average press-cake will contain 30 per cent. of solid matter, of which about two-thirds is cane fibre, so that from 10 tons of cake there are 2 tons of fibre. This same amount can be supplied from 4 tons of bagasse. As the bagasse is coarser it will probably be slower in decomposing, and more may be necessary to give the same effect. Just how much more is problematical, but assume that twice as much, or 8 tons, will be sufficient; bagasse is worth as fuel $2 per ton, so that the material will be worth $16. A ton of press-cake is therefore worth $1·60 for its fibre content.

It may be that the sugars in the cake are important in accelerating the action of the *Azotobacter* taking nitrogen from the air, and to secure this action the sugars should be put on the soil before the crop is planted, while the soil is well aërated. Fresh press-cake seems to work better than old or dried, so it may well be that the presence of the sugars plays an important rôle. Ten tons of press-cake contain 400 lbs. of sugar, which is contained in a half-ton of molasses, invert sugars included. A ton of molasses at $5 would establish a value to press-cake of 25 cents per ton, which, added to its fibre value, gives a total value of $1·85 per ton.

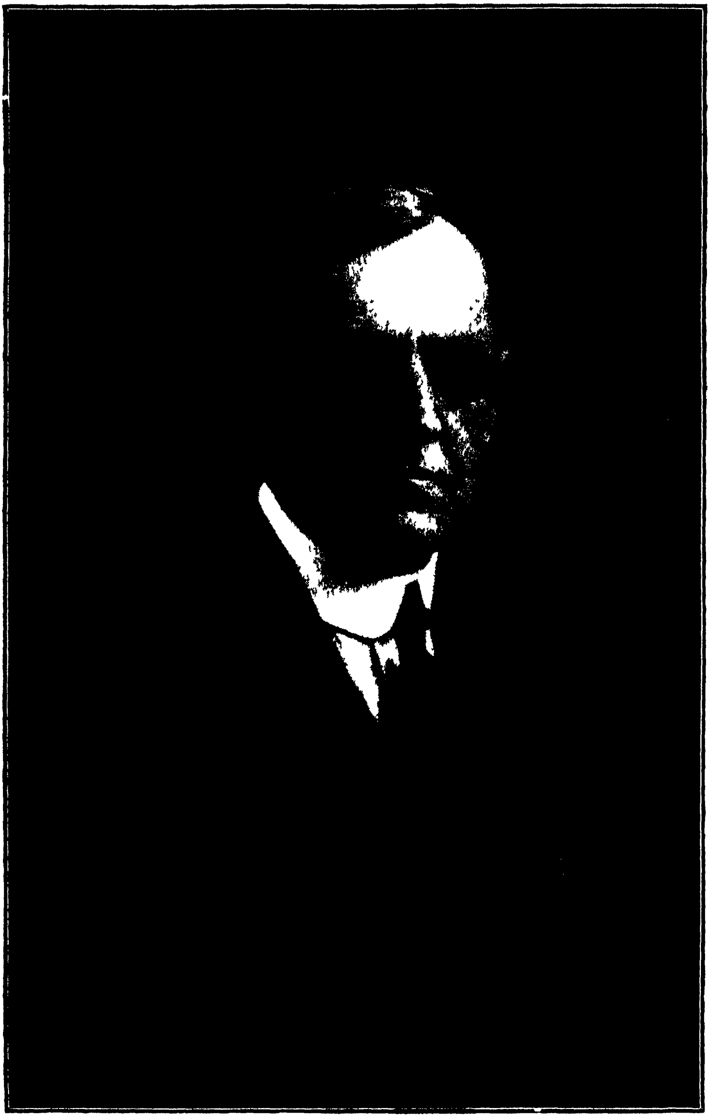
SUMMARY.

An equipment to handle the process in a 25,000 ton factory may cost installed $60,000. The interest on this is $4,800, which will probably be the sole charge against the process outside the fertilizing value of the cake. We would therefore have:—

	$	$
Savings due to process		41,478
Interest	4,800	
Value 5,000 tons cake at $1·85	9,250	
Hauling and spreading bagasse	4,000	18,050
	$18,050	23,428

That is, there is a profit to the factory of $23,428, or 39 per cent. on the investment. This is, of course, only very approximate. Certain economies, such as labour and cloth, are positive; but those calculated on heat conservation and sugar recoveries are speculative. The charges against the process in respect to fertilizer value of the cake disappear in such cases where the cake is hauled out to fields and dropped into irrigation ditches, for here the full, or even at times partial, benefit from the cake is not manifested. All that can be said with any degree of certainty is that the process will make for cheaper work at certain stations; will facilitate boiling-house operations; will conserve heat; will reduce undetermined losses; will do away with the disagreeable labour attending filter-press operations; will produce a cleaner and better sugar; and finally, should pay an adequate return on the investment.

At the ' Rat Week " conference held in London in November, Mr. E. O. REED, technical adviser to the Ministry of Agriculture, stated that he believed many of the mysterious diseases (food poisoning and the like) to be attributable to the presence of rats and mice in human habitations. Sir FREDERICK ANDREWS, Pathologist to St. Bartholomew's Hospital, said that actual outbreaks of food poisoning in human beings had been traced to rat viruses, showing that the diseases that attack rodents may be harmful to man.



NOËL DEERR.

Noël Deerr.

With this issue we have pleasure in reproducing an excellent photograph of Mr. Noël Deerr, well known to our readers as the author of numerous valuable papers on almost every branch of the agriculture and technology of sugar, and also as the writer of the most comprehensive textbook on cane sugar production that exists. There is a general consensus of opinion that no other man within the ranks of cane sugar technologists could have so successfully combined all the different sections into one readable and instructive whole. It must indeed be regarded as a remarkable achievement to have dealt successfully within one cover with several subjects that are practically each the work for one specialist.

Although Mr. Deerr has had a very cosmopolitan life, he has never made light of his British nationality, and British he will doubtless remain to the day of his death, whatever be the lines in which his subsequent working days are cast. The following particulars of his birth, education, and world-wide peregrinations may be found of interest. He was born on December 30th, 1874, the youngest son of the Rev. G. Deerr, vicar of Keresley, Warwickshire, and was educated at Denstone College, and at the City and Guilds of London Institute, a well known training college in London for technologists. He became an Associate of the Institute in 1896 and was elected a Fellow in 1911.

His first engagement in the cane sugar industry abroad was with the Colonial Company in Demerara, 1896 to 1901; thence he transferred to Mauritius, where he worked under the Mauritius Estates and Assets Company for two years (1901-03); in 1903 he went back to British Guiana to serve in Sir Henry Davson's Company, where he stayed till 1905, when he was offered a post at Honolulu as a member of the technological staff of the Hawaiian Sugar Planters Association Experiment Station, and so went to Hawaii. Here he stayed for nine years, and by himself or in association with others of his colleagues he was responsible for a number of Station Reports on special subjects which added greatly to his reputation as a technologist. It was while he was in Hawaii with an excellent library at his disposal that he wrote and had published the first edition of his well-known "Cane Sugar." In 1914 the Cuban Government offered him a post in Cuba as Expert in Sugar Cane Agriculture and Manufacture which he accepted, but doubtless owing to the outbreak of the war this post was of only short duration, and Mr. Deerr transferred his services soon after to the Cuba Company, superintending their Jobabo factory till an outbreak of incendiarism claimed this central as a victim; in this fire Mr. Deerr was unfortunate enough to have destroyed the main portion of his sugar library, an irreparable loss for a man with his bent for research. In 1917 he accepted a post with the Arbuckle Company at their refinery at Brooklyn, which, incidentally, by giving him access to very complete libraries in New York fortunately enabled him to carry out the revision of his *magnum opus* (the 1922 edition) in spite of the loss of his private library. He stayed at Brooklyn till 1921, when he went to Bombay to take charge of some ambitious sugar factory projects of the Tata Company. Unfortunately the drop in the value of the rupee and various difficulties with the native peasantry over the necessary cane supplies led Messrs. Tata to drop all their sugar projects last year, so Mr. Deerr was under necessity of terminating his connexion. He is now associated with Messrs. Begg, Sutherland & Co. of Cawnpore, where we hope he will be able to bring his special talents to bear on the difficult problem of modernizing the Indian cane sugar industry.

Second Annual Conference of Philippine Sugar Technologists.

At Manila, P.I., in October last, the second annual conference of sugar men (planters, engineers and chemists) took place under the presidency of Mr. R. RENTON HIND, who urged that the meeting should organize into an association for the advancement of Philippine sugar. This suggestion was unanimously adopted. A number of papers were read, following which good discussions were evoked. It is possible to find space only for some of the more generally interesting data that were communicated.

OBJECT OF NEW ASSOCIATION.

"The permanent sugar association formed at the Conference has possibilities of great usefulness to the Islands," said Mr. E. W. WILSON, General Manager of the Philippine National Bank, which controls six P.I. Centrals. "The plan contemplates aiding the planter to raise two tons of cane where he now raises but one. Following the experience of other organized sugar countries, and appropriating some of their achievements in seed selection, in better cultivation and deeper ploughing, in drainage and irrigation and in the intelligent use of fertilizer, doubling of cane tonnage may be reasonably expected. As a result of interchange of information between the various departments of each of the mills, resources will be increased and costs will be greatly reduced. Co-operation, and not competition, is necessary in order that the Philippine sugar business be developed to its maximum possibilities. This new organization will supply the thing that has been lacking—co-operative effort."

MATURITY OF THE CANE.

A topic which created wide interest among the delegates present was the plan outlined by Mr. KOPKE for determining the proper degree of maturity in the cane in the field, a point on which the "Warren Tables" are helpful. The sugar centrals of the Agency will adopt this plan during the coming season. Field men will visit the fields of each plantation, test the cane periodically and systematically, and the results of these tests charted on cards will determine the optimum period for harvesting. It is estimated that by cutting cane ahead and letting it lie in the field two or three days before sending it to the mill is the source of from 15 to 20 per cent. loss. It also makes the cane hard to handle in the mill and reduces the mill output—cuts down the season's record. How to obtain co-operation of the transportation systems and the planters is the problem.

LUBRICATION OF MILLS.

Mr. RAY BERDEAU explained a device used at his suggestion in the Victorias Central. It feeds a much lighter oil than is commonly used into the bearings by pressure applied by weights. The object is to minimize the necessity for supervision as much as possible. Such bearings support a pressure of from 350 to 600 tons, and, unless perfect lubrication of both bearings and journals is obtained, shut-downs from overheating will occur. Various methods of lubricating these bearings were explained. Mr. JOSÉ GOMEZ, of Maao, said that at his Central hard oil in screw cups is used, and is comparatively cheaper than other oils. It is necessary to have a man watching these cups all the time and screwing them down at frequent intervals. Engineers at the conference thought it would involve too much risk to place the responsibility for keeping hard oil fed into the mill bearings on a common workman. Mr. GOMEZ answered that it works at Maao.

Mr. Charles Crytser, of the Dearborn Chemical Company, spoke briefly on the merits of the "X" groove on the upper journal. Mr. F. A. Goble said that with wide, deep horizontal grooves from fillet to fillet in both bearings and journals, in the case of a 21-roller sugar mill at Paia, Maui, Hawaii, which had worked through two seasons, giving an extraction respectively 99·05 per cent. and 99·06 per cent., there had been absolutely no trouble in mill lubrication. The oil was fed into the bearings by gravity from a tank at an elevation of 28 ft., and the cost was 3 cents a ton of cane ground, the total cost of lubrication for the entire Central being around 4 cents a ton. The grooves in the journals were ½ in. wide and ⅜ in. deep, and in the upper bearings (none in the lower), ⅞ in. wide and ½ in. deep. The edges were rounded. The cost of lubrication of a mill in the Philippines is said to run much lower, sometimes not above 2 centavos per ton of cane ground.

Many were agreed that no system eliminating the human element can be devised. Supervision is necessary in all cases.

Entrainment during Evaporation.

Mr. José Gomez, manager of the Maao Central, presided at the meeting at which the question of undetermined losses in "entrainment" came up for general discussion. Entrainment means the syphoning of sugar over from the evaporators with the steam into the condensers and its escape with the run-off, or condenser water, some bad cases of which have occurred at some of the centrals, and it has given more or less trouble at practically all of them. Mr. Arnold Warren estimated that the loss last season could not have been less than 200,000 pesos. Other delegates think it was much more than that. Mr. Warren's resolution to have every central report its experiences with entrainment during the 1922-23 season to the Association, in order that the question can be taken up in a practical way at next year's conference, was adopted.

Raw Sugar Sampling.

Mr. Arnold Warren, compiler of the "Warren Sugar Tables," said that the polariscopes used at the warehouses are, many of them, old and defective, and the methods followed in taking samples for testing are also unscientific. He said that the samplers do not go deep enough into the sacks; and they thus abstract sugar that is more moist than the average, and, hence, shows lower polarization. In his opinion, planters on Negros have lost many thousands of pesos by having to submit to such methods, and he strongly urged a polarization station. For every tenth of a degree below 96, ten centavos are deducted from the price; so that if sugar is rated 95 when a fairer test would show it to be 96 degree quality, there is a loss of one peso to the picul.

Roy Alden,[1] reporting on the results of recent automobile fuel tests, stated that at all speeds both with high and low compression the thermal efficiency was higher with alcohol than with petrol or benzol, being equally high at high or low compressions. Tendency to pre-ignition began to be evident at 7 : 1 compression ratio; but the fuel consumption was higher in the case of alcohol, due to its lower heat value. Throttle tests showed the behaviour of alcohol and petrol under variations of throttle conditions to be identical. The maximum output was obtained from the engine when no heat was supplied to the ingoing air; but the thermal efficiency was slightly increased with an increase of heat to the carburettor. Under all conditions the engine ran more smoothly than when using petrol. There was no evidence of any corrosion of valves; and it was noticed that 90 per cent. alcohol seemed to work better than 99 per cent.

[1] *Oil News*, May 9th, 1922.

American Commerce Reports.

PRODUCTION OF SUGAR IN GERMANY.

The production of sugar in Germany from September 1, 1921, to August 31, 1922, shows an increase of 212,769 metric tons over that of the previous year. The following figures show the total production of raw sugar in post-war Germany for the past 10 years:—

Year.	Metric tons.	Year.	Metric tons.
1913-14	2,240,698	1918-19	1,161,676
1914-15	2,131,228	1919-20	701,896
1915-16	1,323,432	1920-21	1,083,851
1916-17	1,341,586	1921-22	1,296,620
1917-18	1,351,768		

Metric ton = 2204·6 lbs.

[Consular Report, October, 1922.]

HUNGARY'S SUGAR CROP.

The total sugar production of Hungary in 1921-22, according to the latest statistics available from Government and industrial sources, amounted to 74,898 metric tons (expressed as raw sugar), or over 10,000 tons more than was estimated a few months ago. The following figures, expressed in metric tons of raw sugar, show that the Hungarian sugar production is sufficient to supply the home demand and to leave a small surplus for export:—

	Metric tons.
Stock, September 1, 1921	3,273
Production, 1921-22	74,898
Imports, 1921-22	45
Total supply, 1921-22	78,216
Consumption, plus exports of 204 tons, 1921-22	71,875
Stock, September, 1922	6,341
Estimated production, 1922-23	75,000
Total supply, 1922-23	81,341

[Consular Report, October, 1922.]

CZECHOSLOVAK SUGAR PRODUCTION AND EXPORT.

The Central Association of the Czechoslovak Sugar Industry has just published the following estimates of the sugar beet crop and raw sugar production in the present campaign, beginning October 1, 1922. They are based on reports received from 156 sugar factories out of a total of 157. In the following table the actual figures for the preceding campaign, 1921-22, taken from a report of the Czechoslovak Sugar Syndicate, are also given:—

	1921-22.	1922-23.
Sugar factories in operation	159	157
Area planted, hectares[1]	195,860	179,761
Sugar beet crop, metric tons[2]	3,461,664	4,195,218
Raw sugar production, metric tons	662,520	668,632
Percentage of raw sugar	19·09	15·93

The statistics for 1920-21 and 1921-22, given below, show that the domestic consumption of sugar in the campaign just concluded, as compared with the preceding campaign, was less by almost 9000 tons, and the exports by 38,000 tons; that is, by 2·81 and 9·28 per cent., respectively:—

[1] Hectare=2·47 acres. [2] Metric ton=2204·6 lbs.

American Commerce Reports.

tems.	1920-21, metric tons.		1921-22, metric tons.
Initial stocks	44,566	..	29,090
Production of raw sugar	717,239	..	662,520
Total..	761,805	..	691,610
Domestic consumption	318,339	..	309,376
Exports	414,376	..	376,328
Total	732,715	..	685,704
Final stocks	29,090	..	5,906

[Consular Report, November, 1922.]

Sugar Industry in Yugoslavia.

The 1921 production of the sugar factories of Yugoslavia is estimated at 22,500 metric tons, according to a report from Consul K. S. Patton at Belgrade. At present the sugar industry is not working at capacity and over 50 per cent. of the needs of the country must be imported.

Trinidad.

Cane Farming and Sugar Crop Returns, 1922.

(Compiled by Edgar Tripp & Co.)

Estate.	Total Sugar Made Tons.	Tons of Sugar made from Estate Cane.	Tons of Estate Cane Ground.	Tons of Cane Purchased.	Amount paid for Canes. $	No. of Farmers. East Indian.	No. of Farmers. West Indian.
Brechin Castle ..	3,600	2381	29,626	15,935	34,419·00	702	514
Bronte	3,945	1983	21,702	23,257	50,232·91	794	315
Caroni Estate.. ..	5,500	†3850	54,842	24,634	63,309·38	1346	1087
Craignish	900	275	3,700	9,060	19,569·60	600	300
Esperanza	3,210	2114	24,567	14,253	30,785·18	550	255
Forres Park	2,333	1314	15,764	13,446	29,043·02	620	159
Golden Grove† ..	500	60	1,080	6,581	14,214·96	120	185
Hindustan†..	1,043	212	2,809	8,758	18,917·28	304	368
Reform	894	—	—	10,814	25,954·60	—	—
Tacarigua Factory..	3,708	1081	13,653	35,128	95,956·47	706	818
La Fortunee	4,347	3314	38,444	12,486	26,969·85	325	270
Usine Ste Madeleine	17,880	7943	76,334	95,551	206,390·16	4072	2651
Waterloo Estates ..	7,438	2920	31,207	54,537	117,799·92	1228	1192
Woodford Lodge ..	4,650	2152	26,630	30,924	79,474·45	1235	631
Total 1922	59,948	29,599	340,358	355,364	813,036·78	12,605	8745
Return for 1921 ..	54,933	24,207	286,974	389,399	1,773,227	15,046	11,379
" " 1920	58,416	28,953	319,421	344,226	2,924,404	14,536	10,524
" " 1919 ..	47,850	24,656	275,451	270,324	1,210,155	12,370	8,568
" " 1918	45,256	22,544	252,783	266,144	812,247	12,158	8,244
" " 1917 ..	70,891	36,102	378,999	384,650	1,093,770	12,055	8,984
" " 1916	64,231	35,653	426,106	363,775	1,008,665	14,014	8,212
" " 1915 ..	58,882	34,376	426,262	325,071	869,790	9,202	7,078
" " 1914	55,488	35,690	407,797	201,799	486,630	7,450	5,253
" " 1913 ..	42,331	31,095	346,912	136,724	330,364	6,942	5,513

† Estimated.

Fifty Years Ago.

From the "Sugar Cane," January, 1873.

In this issue of our predecessor there was little of scientific or technical interest, the articles which were published in it dealing mainly with commercial and statistical matters. However, it may be mentioned that there appeared a emperature correction table for use with Baumé hydrometers, compiled as the results of experiments, not with solutions of pure sugar, but with "a standard liquor of molasses of 42·11°"; and the writer of the note added that "from this it appears that the differences are not proportionate with the temperatures; they are more important between 0° and 10° C. than between 20° and 30° C. As a rule, it may be admitted that with each degree of difference in heat, the indications of aerometers vary $\frac{1}{20}$th of a degree Baumé . . ." There was also a short article dealing with the use of sulphur dioxide in the saccharification of grain in distilleries on the Continent, in which it was stated that "the increase in the glucose under the action of sulphurous acid and the most favourable conditions is found to vary from 2 to 3 per cent. of the weight of grain employed. . . It is probable that the sulphurous acid during the process of maceration dissolves slowly the gluten and other albumenoid substances which envelop the starch in the meal, and thus the immediate contact of the starch granules with the solution of the diastase is promoted during the saccharification . . ."

It remains only to notice a few patents which were abstracted in this issue. J. Barrow and C. J. Crosfield[1] claimed for a procedure which consisted in separating by filtration through a special filter-press the small crystals of sugar from saccharine syrups given off from centrifugal machines used in the drying of massecuite, the syrup at about atmospheric temperature being filtered through cloth. J. V. P. Lagrange[2] disclosed a method for the clarification of juices and syrups, etc., in which ammonium phosphate was introduced into the liquid for the purpose of precipitating the calcium salts which had resisted the action of the CO_2 during carbonatation, barium hydroxide being added either before or after the reagent mentioned, in order to avoid the formation of ammonium sulphate, and in order to effect the elimination of calcium sulphate. In another process of clarification, protected by S. Dod,[3] of Havana, Cuba, the juice or other liquid, after being limed or otherwise purified, was pumped into four connected closed boilers heated uniformly by a furnace, the steam generated in these boilers being utilized for working the engines and pumps of the plant and for other requirements. It was stated in this specification that the high temperature to which the juice or syrup was exposed under pressure in the manner described purifies it, so that the use of boneblack, etc., was then unnecessary, though one would surely expect the contrary to be the case. Even fifty years ago attempts were being made to produce carbonaceous decolorizing preparations, and F. L. H. Danchell,[4] of Horwich, Lancs., described "a homogeneous combination of carbonaceous matter with certain mineral matter, the proportions of these substances being such that the first should constitute from 10 to 15 per cent. of the whole after charring, and the mineral the rest. . . ."

[1] English Patent, 1171 of 1872. [2] E. P., 1437. [3] E. P., 3588.
[4] E. P., 1394.

Publications Received.

The Warren Tables for estimating the Percentage of Sugar in Cane from the Polarization and Apparent Purity of the First Expressed Juice. By Arnold H. Warren. (Philippine Sugar Centrals Agency, Masonic Building, Manila, P. I.) 1921. Price: $12·50.

It is generally conceded that Noël Deerr's *S-J-M* formula provides the most accurate basis for the calculation of the amount of commercial sugar which can be produced from the juice entering the boiling house of the cane sugar factory. In the P. I. use is made of it in many of the centrals for the estimation of the amount of sugar due to the planter as the price of the cane delivered by him, a separate analysis of his juice as it leaves the crusher (or feed-roll of the first mill) being made. But the routine application of this formula involves a good deal of calculation, especially when the estimation has to be repeated frequently according to the number of cane lots from individual farmers. Mr. E. W. KOPKE had suggested that it would be an advantage to combine the use of a "quality ratio" table based on Winter's formula and a factor of correction involving the actual milling conditions of the factory; but Mr. WARREN (of the Calamba Sugar Estate, P. I.) has improved on this idea by preparing a set of tables based on the more reliable *S-J-M* formula (for molasses gravity purities 31–50^{c}), in which, by the incorporation of a factor, due allowance may be made for losses of sucrose other than in the molasses, viz., in the bagasse and press-cake, and those which are undetermined. It has been his aim in compiling these tables to provide for a wide range of variations in the quality of the cane milled and the molasses discarded, and further to take into consideration widely varying operating conditions. Hence they should permit of a high degree of refinement in the accuracy of the estimation of the amount of *AS*, while also reducing to the minimum the labour involved in such computations. Already in the P. I. the Warren Tables have been adopted by several of the centrals; and there seems little doubt that their advantages will readily be recognized by the cane sugar industry at large.

Betterave et Sucrerie de Betterave. By E. Saillard. Third Edition, entirely revised. Part I. (J.-B. Baillière et Fils, Paris). 1923. Price: 10 francs (paper covers); 15 francs (bound).

Two editions of this well known French work have appeared,[1] and a third (this time in two parts) is now being issued. The first part, which we have before us, deals with the methods of analysis to be followed in the case of beet factory products, and the application of the results thus obtained to the purpose of chemical control and the computation of the losses of sucrose, determined and undetermined; while the second part, which will be published shortly, will treat of the agriculture of the beet and the manufacture of sugar from it.

Mr. SAILLARD exposes his subject *à fond;* and if only for the satisfactory way in which he deals with the elementary principles of chemical analysis as used in the sugar factory (particularly concerning densimetry, aerometry, and optical and chemical saccharimetry), his book must be recommended to the young chemist, who will find in its pages a good deal of information absent in most other textbooks. But there is much more in this work. After the reader has acquired these principles, he is shown their application to matters such as the analysis of the beet (with a discussion of the results given by the alcoholic extraction, alcoholic digestion, and hot aqueous digestion and cold aqueous digestion methods), of raw and clarified juices, of syrups, of molasses, etc.; and in certain of these sections it will be observed that a frank discussion is made of the comparative value of the several processes described, a feature which might very well be emulated by other writers of textbooks on chemical analysis. The book closes with two useful chapters. The first is a description of chemical control in the beet sugar factory (which on

[1] *I.S.J.*, 1913, 381.

the whole is a simpler affair than in the cane industry) and of the calculation of the losses, while there are showing what under normal conditions these losses, both determined and undetermined, usually are at the different Stations. In the last chapter, the author gives an interesting account of his own investigations on the fate of certain constituents of the beet (viz., dry substance, nitrogen, chlorine, alkalis, and phosphoric acid) during the course of manufacture, balance-sheets indicating where these substances are finally to be found being shown. This seems an interesting line of study, which might also be applied to effect in cane sugar manufacture, though it will be remembered that the late J. J. HAZEWINKEL attempted in the case of the dry substance only to construct a balance in the case of defecation factories in Java.

The Principles of Jelly-making. By N. E. Goldthwaite, Ph.D., Bulletin No. 31; Department of Household Science of the University of Illinois, Urbana, U.S.A.

About five years ago, Dr. NELLIE E. GOLDTHWAITE carried out at the Research Laboratory of the Department of Household Science of the University of Illinois a series of experiments for the purpose of establishing the conditions upon which the making of fruit jelly depends[1]; and her results are now recognized as having transferred the practice of the art from an empirical to a scientific basis. Housewives in America and in this country should be keenly interested in this bulletin in which in simple language the principles developed in these researches are discussed, and the rationale of successful jelly-making is exposed. Dr. GOLDTHWAITE shows that "good jellies cannot be made from all juices by rule of thumb. Jelly-making, as practised in the home, is an art, an art founded on scientific principles. It consists in so controlling results by means of sugar and acid, and by boiling, so as to cause the pectin to set in a continuous mass throughout the volume allotted to it."

Scientists' Reference Book and Diary for 1923. (Jas. Woolley, Sons & Co., Ltd., Manchester). Price: 3s. 6d.

On previous occasions we have called attention to this reference book and diary, a most useful one to the chemist and engineer. It contains *inter alia* a digest of modern developments in physics and chemistry; data regarding barometry, thermometry, and hydrometry; laws and definitions in chemistry and physics; data on dynamics; mensuration formulae; electrical units; data on heat, light and electricity; tables of logarithms; numerous chemical data (as solubilities, atomic and molecular weights, analytical factors); data regarding weights and measures, etc., etc. This information and a good deal more besides is conveniently arranged and indexed, and the book (which measures 3 in. × 5¾ in.) is strongly bound in artificial leather. It is an excellently edited compilation.

How to Form a Company. Herbert W. Jordan. Fifteenth Edition. (Jordan & Sons, Ltd., London.) 1922. Price: 1s. 6d.

This is a well-known small book, which explains in a very clear way the documents which must be filed on incorporation, and the principal statutory requirements affecting companies registered within the United Kingdom. It has run through no less than 15 editions since 1913; and is a valuable guide for the company secretary and director in supplying information dealing with company incorporation and the formalities to be complied with in carrying on a limited liability business.

Dust Explosions. By David J. Price and Harold H. Brown. 320 pp., illustrated. (National Fire Protection Association, Boston, U.S.A.) Price: $3. 1922.

[1] *Jl. Ind. Eng. Chem.*, 1909, 1, 333-344; 1910, 2, 457-462.

Brevities.

The duty on boneblack and decolorizing carbon going into the United States has been fixed at 20 per cent. *ad. valorem.*

It is reported[1] that in Germany the use of barium compounds for the purification of sugar juices or syrups in manufacture or refining is prohibited.

An intensive campaign against the rat is being waged in the Island of Hawaii by the Board of Health in co-operation with plantations. Several deaths from bubonic plague have recently occurred, all of which have been traced to infected rats.

If an applicant for a British Patent wishes to know what patents were discovered by the examiners in the searches which they make under the Statute, he is now able to obtain this information by making enquiry at the Patent Office, London, on the payment of a fee.

In Cuba it is estimated[2] that the cost per gallon of alcohol motor fuel produced by a plant utilizing molasses and producing 7200 gallons of the spirit per day of 24 hours would be 12·55 cents per gallon, and it is considered that such fuel would command a ready sale at 20 cents.

At Lufkin, Texas, U. S. A., a plant for the production of 500,000 gallons of table syrup per season by the invertase method has been erected. It is claimed that this method, while resulting in a clear and uniform product, sacrifices none of the rich flavour which characterizes the home-made syrup.

Imports of sugar for refining at Formosan mills, says a Consular Report, show an increase in quantity but a decrease in value, and Cuba seems to be displacing Java to some extent as a source of supply. Nearly 30,000 tons of Cuba sugar have been imported since January 1922, largely in British bottoms.

Mr. Geo. F. Renton, Jr, Manager of Ewa Plantation, T.H., reports[3] that 118·23 tons of cane per acre, yielding 15·02 tons of sugar per acre, were obtained from three irrigated fields of his Company's estate, H109 cane being planted. However, the average for the Ewa plantation was 8·71 tons and for the whole of Hawaii in 1921, 5·5 tons.[4]

Mr. V. L. G. Gerrard has resigned his partnership in the firm of Messrs. H. H. Hancock & Co., the well known Mincing Lane Brokers, as from December 31st last. This step has been taken by reason of the indifferent health from which he has suffered of late. He has however been re-elected to membership of the Terminal Market Association, and is looking forward to a return to Mincing Lane after a period of rest.

As the result of official trials carried out in the Belgian Congo, it was concluded that palm oil may be used with satisfactory results as the sole fuel in semi-Diesel 2- or 4-cycle engines, power being developed at least equal to that obtained with kerosene. Starting up was good; it was unnecessary to use motor spirit injection; and there was no carbonization. In tractor propulsion entirely satisfactory results have been obtained, nothing having been noted suggesting possible difficulty in the use of this fuel.

Queensland produces 62,500 tons of molasses of which 15,000 are used for the manufacture of methylated spirit, while the remaining 27,500 might be used for the production of about 3 million galls. of alcohol for use as motor fuel. However, the denaturing restrictions still stand in the way of this development. At present 2 per cent. of wood naphtha, ½ per cent. of pyridine, and ½ per cent. of coal tar naphtha (or similar substance) is the mixture required by the Commonwealth Excise; but these materials for the greater part have to be imported and form a costly addition. Automobile clubs and other interests are urging that the admixture of 10 per cent. of benzol be accepted as a sufficient denaturant, or that alternatively a bonus of 7d. per gall. be allowed.

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[1] *Centr. Zuckerind.*, 1922, 30, 65. [2] *The Board of Trade Journal*, November 16th, 1922, p. 563. [3] *Facts about Sugar*, 1922. 15, No. 3, 48. [4] *Ibid.*, 1922, 14, No. 23, 452.

Review of Current Technical Literature.[1]

BONEBLACK (ANIMAL CHARCOAL) DECOLORIZING CARBON IN SUGAR REFINING.[2] *W. D. Horne. Journal of Industrial and Engineering Chemistry, 1922, 14, No. 12, 1134–1136.*

In refining, 75 to 100 lbs. of boneblack are ordinarily used for the treatment of each 100 lbs. of raw sugar, and removes one-third to one-half of the organic impurities; about three-fourths of the total colour; and one-fourth to one-third of the mineral substances. On the other hand, only 3 to 10 per cent. of decolorizing carbon may be applied in place of the char, and will be found to eliminate at least two-thirds of the colour without, however, absorbing any notable amount of ash.

A refinery working 225 days a year can count on its boneblack wearing out in three years. As it makes the cycle of its operations about once in three days, in the first year the full char will be used 75 times, in the second year two-thirds will be used 75 times, in the third year one-third 75 times, making 150 times in all, calculated for the full char. If boneblack can be used 150 times, it will be necessary to use this carbon through 12·5 cycles of seven mixings with liquor in each cycle to get the same decolorizing effect. As the vegetable carbons are rather soft, they have been found to wear down under the attrition of use, and, as the grains grow smaller, gradually choke the cloths of the filter press. It seems a fair assumption, from experience in this field, that 18 cycles of this kind would nearly exhaust the utility of most vegetable carbons. In other words, by the time this carbon has done 150 per cent. as much decolorizing as an equal weight of boneblack can do in its whole life, the carbon will have been exhausted. On a colour basis alone, then, it appears that such a carbon must not cost more than 150 per cent. as much as char does per lb. The cost of boneblack can be taken at about 5 cents a lb. net, as an allowance can be made for old boneblack sold on its phosphoric oxide content. This carbon, then, should not cost over 7·5 cents per lb., on a colour absorption basis. With regard to ash absorption, however, the average raw sugar contains about 0·6 per cent. of ash, of which the boneblack treatment removes from 0·2 to 0·3 per cent. The carbon failing to do this, the above-mentioned 0·2 per cent. of ash holds back about five times its weight of sugar from crystallizing, or 1·0 per cent. on the weight of raw sugar melted. The 0·4 per cent. of ash left after char filtration is ordinarily accompanied by the production of about 4·5 per cent. of final molasses. If none of the ash is removed, we might expect to have half again as much molasses; but the carbon removes organic impurities which also have a melassigenic influence, and so it is probably more nearly correct to assume that there will be about one-quarter more molasses with carbon than with boneblack. Thus, 100 lbs. of raw sugar treated with 80 lbs. of boneblack should produce 93 lbs. of refined sugar at 5·1 cents per lb., or $4·743, and 4·5 lbs. of molasses at 1 cent. or $4·788 altogether. The same amount of raw sugar refined with carbon would give about 92 lbs. of sugar ($4·692) and 5·625 lbs. of molasses at 0·8 cent per lb. (cheaper because of its higher ash content), worth 4·5 cents or $4·737 altogether, which is 5·1 cents less than when boneblack is used. The cost of the 80 lbs. of char needed for handling 100 lbs. of raw sugar at 5 cents net is $4·00, and if this can be used in all 150 times, the cost for a single use will be 2·66 cents. Since the boneblack thus effects a saving, compared with carbon, of nearly twice as much as the boneblack costs, it is evident that such a carbon cannot compete with it at any price. To offset this, there would be a saving on the erection of a plant to use carbon instead of char; and, as revivifying processes develop, there may be economy here also, owing to the smaller weight of the carbon handled.

But the great object at which to aim is the production of an ash-absorbing carbon, as, e.g., one consisting of a porous mineral foundation overlaid with a highly activated carbon, one capable if possible of being handled in filter-presses, in the same convenient manner as carbons, and especially one having a high capacity for removing salts from

[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*, 298.

[2] This is a fuller account of a paper read before the Division of Sugar Chemistry at the 63rd Meeting of the American Chemical Society, Birmingham, Ala., already abstracted, see *I.S.J.*, 1922, 298.

solution. In the case of bone char, it is the skeleton of calcium phosphate that takes up the ash,[1] and is demonstrated by the following results obtained from whole bone char, its skeleton resulting after the carbon has been eliminated and the carbon left after the solution of the mineral matter by hydrochloric acid:—

	Original Solution.	Whole Boneblack. First 25 c.c.	Whole Boneblack. Second 25 c.c.	Burned Boneblack. First 25 c.c.	Burned Boneblack. Second 25 c.c.	Carbon from Boneblack. First 25 c.c.	Carbon from Boneblack. Second 25 c.c.
Colour	103·0	4·0	20·0	27·0	60·0	8·0	16·0[2]
Colour absorbed, per cent.	—	96·10	80·58	73·80	41·78	92·30	48·50
Ash (on dry substance), per cent.	2·914	1·535	2·133	2·235	2·378	2·678	—
Ash absorbed, per cent.	—	47·32	26·80	23·30	18·39	8·10	—

That the mineral portion of the char is the agent in taking up most of the ash is borne out by the behaviour of an artificial char formed by the fixation of carbon on a more or less porous earthly substratum, as shown by the following figures.

In a filtration test arranged much as was the one just described, the artificial char was compared with high-grade boneblack, with the following results:—

	Original Liquor.	Boneblack. First 30 c.c.	Boneblack. Second 30 c.c.	Substitute. First 30 c.c.	Substitute. Second 30 c.c.
Colour	100 0	2·0	6·0	10·0	24·0
Colour absorbed, per cent.	—	98·0	94·0	90 0	76·0
Ash (on dry substance), per cent.	2·81	1·84	—	2·12	—
Ash absorbed, per cent.	—	34·52	—	24·60	—

If this hint is followed, we may eventually expect to be able to develop a decolorizing carbonaceous compound, which will not only take up colour, but will also absorb ash. When viewed from the financial standpoint of the refiner, this is an important matter.

Experiments on the Preparation of Decolorizing Carbons, and on the Use of Cane Trash as a Filtering Medium.[3] *C. E. Coates. Facts about Sugar, 1922, 15, No. 13. 257.*

Dr. Coates began experimenting on decolorizing carbons in 1910, but obtained poor results, with peats and lignites. Next, he tried sawdust, and although some good preparations resulted from impregnation with magnesium chloride, etc., their cost was too great. About 1915, "Norit" was first tried in Louisiana, arousing general interest in the subject. In September, 1917, he reported at the Boston meeting his experience in heating carbonaceous materials in crucibles to burn off the hydrogen, which increased the decolorizing power of the carbon. The many investigations made on gas-absorbing carbons after that time gave little aid to those investigating the colour absorption properties of carbons, as these functions are apparently due to different causes. In the early experiments attempts were made to increase the colour absorbing power of lampblack by treating it with various solvents; but this only led to a small improvement, i.e., a rise from 25 to 31 per cent. of colour absorption. On heating to 600°C., however, in a crucible with the admission of a little air,[4] the value rose to 88, while without the admission of air, values of between 50 and 60 were obtained on a scale in which "Norit" showed a value of 81. Next "Aquadig," or Atchison's deflocculated graphite, suspended in water, was found to have a very low power; but unctuous graphite showed a power of 33, being slightly greater in acid than in alkaline solution. Fuller's earth gave a colour removal of from 4 to 7 per cent., and this also was a trifle better in acid than in alkaline solution. Ordinary clays gave very little colour absorption. Boneblack, on digestion with acid to remove all but from 7 to 18 per cent. of the ash, was found to equal "Norit." Rice hulls heated to 850°C. removed 52 per cent. of colour; "Kelpchar," 99 per cent.; "Norit" and "Carbrox," 94 per cent.; and "Darco," 94 to 97 per cent.

[1] As has long been known.—Ed., *I.S.J.*

[2] Colour of liquor supernatant to the carbon. It would no longer percolate through.

[3] This is an amplification of an abstract of Dr. Coates' valuable work which we recently published. See *I.S.J.*, 1922, 533.

[4] *I.S.J.*, 1919, 619.

Returning to the experiments on sawdust carried out in 1917, the author found on heating to 500°C. to expel gases, a slight decolorizing power was obtained, equal to about 27. However, when this material was heated to 850°C. the decolorizing power rose to 85 per cent. It was found that as the hydrogen present in the carbon decreased, the decoloring power increased, showing very plainly what a strong inhibiting action hydrocarbons exercise upon a decolorizing carbon.[1] Lastly, the author calls attention to the latent value in the cane trash, left upon the fields as a waste material. This material frequently contains 35 to 40 per cent. of ash, differing radically from cane fibre; but nevertheless it can be made into a decolorizing carbon and an excellent filter aid at about $18 per ton. This trash char is as good as infusorial earth as a filter aid, and has a decolorizing power exceeding many commercial chars, being able to abstract about 70 per cent. of colour, against 70 to 80 per cent. taken out by a high-power decolorizing carbon.

PRECIPITATE FORMING IN EVAPORATOR SYRUP AFTER CLARIFICATION, AND ITS PREVENTION. *Maurice Bird. La. Planter, 1922, 49, No. 4, 61.*

Referring to the recent contribution to this subject by MR. BIRCKNER,[2] the author remarks that he has also analysed the precipitate which appears in syrups, and has found the silica content to be about the same, viz , 34–37 per cent. He has attacked the problem along the lines suggested in the article by CHAS. MÜLLER,[3] who stated that if before liming the juice be heated to 248°F. (120°C.) for one minute, organo-silicious compounds are decomposed, and the quantity of the juice greatly improved. If in practice it proves unfeasible to heat the juice to the degree named, very good results are obtained by heating (in juice heaters) to 220°F. (104°C). By this means a precipitate is obtained which weighs when dried about 0·4 per cent. of the weight of the juice and may be strained off fairly well by means of inclined sheets of the finest mesh wire gauze (100 mesh to the square inch). Juice so treated requires from one-third to one-half the lime to clarify it that is demanded by the same juice not so pre-heated. At Skeldon Plantation (British Guiana) a factory trial was made as follows: The juice was heated before, before liming, to 220°F. (104°C), or thereabouts, then limed in the usual way without straining off the precipitate caused by the preheating before liming, for which we had no facilities. The settling, etc., of the juice, after liming, being carried out in the usual way. Sufficient sugar (some 2000 tons) was made with this innovation to show that beyond doubt it exercised a marked improvement on the yield and quality of the product. The low grade sugars grained and cured especially well, very little water being necessary for the curing, a final molasses several degrees lower in purity than had before been obtained in that factory resulting. The author feels that the process is worth a fair trial under auspicious conditions, and its effect on clarification will probably be far reaching.

A STUDY OF THE RELATIONSHIP BETWEEN SUGAR, PECTIN, AND ACID IN JELLY MAKING. *Lal Singh. Journal of Industry and Engineering Chemistry, 1922, 14, No. 9, 710–711.*

In the preparation of jelly from a mixture of sugar, pectin, acid, and water, a definite relationship exists between the amount of acid present (e.g. in the fruit juice used) and the amount of sugar added. Between certain limits, the greater the acidity of the juice the lower the amount of sugar required. It is therefore desirable to increase the acidity of the juice to the maximum limit compatible with taste, in order to save sugar. Within certain limits, the higher the percentage of pectin in a fruit juice, the lower the amount of sugar necessary to form a jelly. After a certain concentration of pectin in a jelly is reached, any excess remains inactive. By increasing the pectin in a juice from 0·9 per cent. to 1·5 per cent., a jelly maker can easily save over 15 per cent. of sugar. It is also noted in this article that the lemon peels which go to waste at citric acid factories would yield pectin at the rate of 90 lbs. per ton of waste peels.

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[1] Refer to the paper by CHANEY, *I.S.J.*, 1920, 229.
[2] *I.S.J.*, 1922, 605. [3] *I.S.J.*, 1921, 579.

Cost of Production of Alcohol Motor Fuel in Cuba. *Raymond Carpenter.* *Facts about Sugar, 1922, 14, No. 20, 390-392.*

After giving a general outline of the manufacture of alcohol motor spirit, the author states the cost of production in a plant capable of utilizing the molasses output of a 3000-ton raw sugar factory, which is supplied from outside sources with additional raw material to keep it in operation all the year round, the output of the plant being 7200 gallons of motor fuel containing ether per day:—

Materials:		
Fuel oil, 22,000 lbs. per day at 0·7 cent. per lb.		$154 00
Molasses, 18,000 gallons per day at 1 cent (present value)		180·00
Acid, caustic, and denaturant, per day		90·00
Miscellaneous supplies, per day		5·00
		$429·00
Labour and Supervision:		
Operation in two shifts and including office force, per day		158·00
Capital Charges:		
Interest at 10 per cent.	$50,000	
Depreciation at 5 per cent.	25,000	
Taxes and insurance at 3 per cent.	15,000	
Maintenance at 1 per cent.	5,000	
Per year	$95,000	
Per day		316·67
Total daily cost		$903·67
Total cost per gallon of fuel produced		12·55c.

As a basis for calculation of net earnings, the plant is assumed to be erected and ready to operate, and to have $500,000, plus a working capital of $100,000, making a total of $600,000. Assume the product to be sold f.o b. plant for 20 cents. per gallon. This gives a net profit per gallon of 7·45 cents. On one year's production the net revenue will be $160,920, nearly 27 per cent. on the total investment assumed. This price of 20 cents per gallon is conservative. It allows the fuel to be retailed at 35 cents in competition with gasoline, with a margin af 15 cents between factory price and retail price to cover cost of distribution and profit to the distributors, and it anticipates a possible cut in the price of gasoline where the present price is 50 cents. It may be objected that molasses ought to be put in at 2 cents per gallon; but granted that it is worth 2 cents, the profit per lb. is reduced to 4·95 cents, the yearly revenue to $96,920, and the dividend to a little more than 16 per cent.

Automatic Lining of Cane Juice. *N. A. Helmer.* *La. Planter, 1922, 49, No. 7, 103-104*

Having been delegated by Mr. E. Antonio Vazquez to look over a soap works near Havana, and particularly to inspect a water softening plant made by a prominent firm in Philadelphia, the idea occurred to the author that a portion of this apparatus might be modified to supply milk-of-lime to cane juice in an automatic manner. So the firm referred to gave their consideration to obviating the difficulty of varying the feed of milk, making it capable of variation not only in proportion to the quantity of juice being pumped, but also capable of being modified according to the degree of alkalinity required, when burnt or inferior cane was being milled. The principle upon which the device originally worked was due to the creation of a differential pressure by means of an orifice plate inserted in the discharge of the pump, and this served admirably because the water was usually of constant quality even though it varied in quantity through a range of from nothing to maximum. This differential pressure operated a device which regulated the flow of milk constantly supplied by a special pump. Instead of the orifice plate, however, a special form of regulator was devised, operated by a worm wheel and worm,

to which latter was attached a graduated hand wheel, the appliance being closed in a box. This gave unusually fine adjustment to the device, and as the guarantee with the orifice plate was to supply the reagent within 2½ per cent. of the theoretical required (the actual result being less than 1 per cent. variation). Here, then, was an apparatus that had been for years supplying milk-of-lime at 15° Be. to water softeners automatically in proportion to the quantity of water pumped, and at a ratio fixed by the analysis of the water which was practically constant, converted into an automatic cane juice liming apparatus with the additional characteristic of permitting an instantaneous change in the proportion by a graduated hand wheel after the containing box had been unlocked.

PROBLEMS REGARDING PLANT EQUIPMENT, LABOUR AND FUEL, INVOLVED IN THE PRODUCTION OF WHITE GRANULATED BY THE USE OF DECOLORIZING CARBONS. *Walton C. Graham. Facts about Sugar, 1922, 15, No. 22, 438-444.*

It is assumed that a raw sugar factory is contemplating the adoption of decolorizing carbon for the production of white granulated, the procedure being first to produce a sugar of about 96°; wash in the centrifugals to white crystals of 99° purity; remelt these to a liquor of about 30° Bé. or 60° Brix; treat with decolorizing carbon; and, lastly, boil four successive massecuites. It is neither practicable nor profitable to use the same equipment for boiling and curing both the raw and the white alternately, and so a special set of plant, from the storage tanks to the last detail of the vacuum pan, centrifugals, pumps, mixers, etc., must be provided. An estimate may be made of the quantities of the various products, an average yield of 50 per cent. being taken in each case, and the amounts in massecuite of 90 per cent. dry substance, syrup of 60 per cent. dry substance, and sugar of 100 per cent. dry substance being calculated, with the following results:—

TONS OF MATERIAL, PER 100 TONS 99° RAW SUGAR.

Number.	Syrup.	Massecuite.	100° Sugar	Dry Substance.	Purity.
1	166·6	111·0	50·0	100·00	99·0°
2	83·2	55·6	25·0	50·0	98·0°
3	41·6	27·8	12·5	25·0	96·0°
4	20·8	1·40	6·25	12·5	92·0°
Totals....	312·2	208·4	93·8	187·5	

It is assumed that with a good decolorizing medium as claimed, white sugar should be obtained in the four succeeding massecuites, the quantity of sucrose remaining being $100-93{\cdot}8 = 6{\cdot}2$ tons of 84° purity molasses. In a raw sugar house, the massecuite and dry substance handled have been calculated in a typical case to be 211 and 190 tons respectively; while as shown above in making white granulated the figures are 208·4 and 187·5 tons. Thus it is seen that a refining operation duplicates the handling of material and requires that the entire boiling-house equipment must at least be doubled, which condition would apply also to the labour required. Further, where in making the raw sugar the bagasse just about supplies the fuel necessary, in the refining process additional coal or oil must be supplied; and additional boilers, power, and many other items would also be required. Let no one interpret these statements as meaning that a process of plantation refining (either for the production of all the crop as white granulated, or a part only) may not be entirely practicable and profitable. It has not been intended to do this: merely to point out that certain additional equipment, labour, and other items must be taken into consideration in the expense account.

DECOLORIZING VALUE OF WEINRICH'S "MOLASS-CHAR"; AND SOME REMARKS ON TECHNICAL COLORIMETRY. *Communication by the Bureau of Standards, Washington, to the late M. Weinrich, dated December 21st, 1921.*

"Molass-char"[1] in four different grades, No. 1 granular, and 2, 3, and 4 powdered, were dried at 105°C., added to Cuban raw sugar liquor at 50° Brix, at the rate of 5 per cent. of the polarization, the natural acidity of this liquor being equivalent to 0·045 grm. of CaO per cent. of dry substance. A temperature of 80-85°C. was used, and contact

[1] *I.S.J.*, 1922, 606.

was maintained for 10 min., the flask containing the mixture being shaken at intervals to ensure complete adsorption. At the end of the time stated, the carbon was separated in a laboratory centrifuge lined with a moistened thick filter-paper, and the turbid liquid resulting was re-filtered under vacuum through a Buchner funnel, thereby producing what is called here the "technical filtrate." This was shaken up with long-fibre asbestos (1·5 grm. per cent. of the syrup); and after 10 minutes' contact the liquid was passed through an empty Gooch crucible. Although transparent in daylight, this "chemical filtrate" was not then clear enough for optical analysis, and was therefore re-filtered four to six times through specially prepared asbestos pads.[1] This "optical filtrate" must be transparent when employing the Tindall test in the dark room, not more than a faint haze being perceptible. If the turbidity be too great, then the clarification by filtering through asbestos pads must be repeated. These several solutions were then examined in the spectro-photometer, and tested for their Brix, polarization and purity values, the following being the results obtained:—

	Original Liquors.	"Molass-char" treated liquors. No. 1 grade.	No. 2 grade.	No. 3 grade.	No. 4 grade.
Brix (refractometer)..	55·30	46·29	43·1	42·36	46·3
Polarization	53·65	45·1	42·0	41·45	45·0
Purity	97·02	97·51	97·45	97·85	97·19
Colour removed, per cent (average)	—	13·2	17·3	43·5	84·4

Other carbons than "Molasschar" were examined at the same time (but the results are not here reproduced) and the best of these eliminated 90–96 per cent. of the colour originally present, "Molasschar" No. 4 being fourth in the scale. Commenting upon these results, the late Mr. Weinrich stated:—"Molasschar" No 4, which is a vegetable carbon low in ash, has shown up very well as a decolorizer; but, like all other vegetable carbons, it removes only small amounts of impurities from sugar solutions, very much less than good boneblack does. This is the reason why vegetable carbons have found little favour with sugar refiners, at least not for the filtration of wash-syrups, while they would do well in the decolorization of washed sugar liquor. These objections would be overcome by my "Molasschar" No. 2, which can be manufactured for about $10 a ton, and by my No. 3 "Molasschar," which can be manufactured for about $20 a ton. Their decolorizing power when using equal weights is much less than that of No. 4 and other carbons; but it is about the same, particularly of No. 3, when using equal volumes. It is well known that vegetable carbons are very light and in their dry state weigh only about 12 lbs. per cub. ft., while my "Molasschar" No. 3 weighs about 25 lbs., and my "Molasschar" No. 2 over 30 lbs. per cub. ft. When using, therefore, equal volumes, my No. 3 char would decolorize fully as well, and my No. 2 char about half as well as vegetable carbons, while they would remove simultaneously quite considerable amounts of organic and inorganic impurities. Since the working expenses in the char-houses of refineries, may cisterns or filter-presses be employed, are generally calculated by the number of filter-apparatus filled and emptied daily, such comparison is only just. My No. 2 and No. 3 chars have to be used, like carbons, by means of filter-presses. My "Molasschar" No. 1, which is granular and practically as hard as new bone-black, has to be used in cisterns in its granular state, like bone-black. In the experiments made by the Bureau of Standards, the samples were ground into a powder and tested as such, using 5 per cent. of the weight of the sugar in the solutions, the same weight as was used with the other samples of "Molasschar" and other carbons. . . . . The foregoing report of the Bureau of Standards will sustain my claims that my No. 1 char is a cheap and effective substitute for bone-black, and that my No. 2, 3 and 4 can be used with excellent results in filter-press work, while their cost of manufacture is exceedingly low."

J. P. O.

[1] One would expect these filtrations through asbestos to affect the results by diminishing the colour due to separation of colloids.—Ed., *I.S.J.*

Review of Recent Patents.[1]

UNITED KINGDOM.

ROTARY TOOL FOR CUTTING CANE. *A. Barbezieux and L. Maurel,* of Paris, France. *187,270.* May 20th, 1920.

A portable tool for cutting cane has its driving mechanism provided with cushioning devices for facilitating starting and stopping. The tool comprises a hand-supported frame *1* enclosing a multiplying gear train connected to a shaft *4* on which is mounted a circular saw *3*. The multiplying train is driven by bevel gear from a shaft *17* mounted in ball bearings in the frame and provided with a double-thread *19*. The end of the shaft *17* projects into a sleeve *20* which is secured to the end of a flexible driving shaft *23*. Studs

FIG I

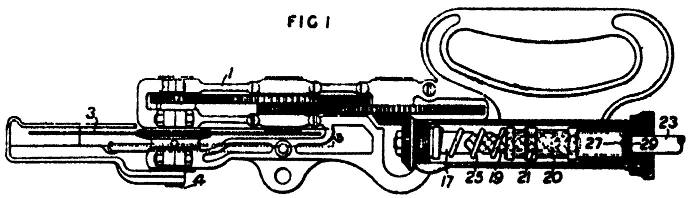
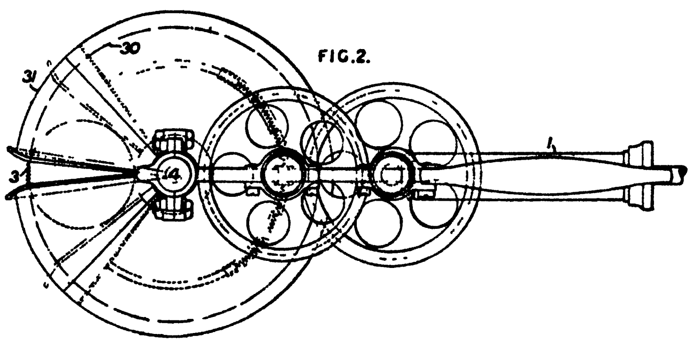


FIG.2.



21 on the sleeve engage in the screw-threads on the shaft *19*, and when shaft *23* commences to rotate, ride up these threads compressing a spring *25* encircling the shaft *17*. A ball *27* bears against the shaft *17* when it reaches the end of the sleeve. When the rotation of the flexible shaft is stopped the sleeve moves off the shaft *17* until the studs engage grooves in the shaft at right angles to its axis thus permitting the cutter and its multiplying gear to rotate freely. A spring *29* forces the studs *21* into the screw threads when the flexible shaft is rotated. Hinged covers *31* which may be pressed back within a fixed case *30* protect the cutter when it is not in use.

PREVENTION OF CORROSION IN STEAM CONDENSERS, HEATERS, ETC. *F. von Wurstemberger,* of Zurich, Switzerland. *185,436.* March 8th, 1921.

In a surface condenser or like apparatus having tubes and a tube-supporting plate made of copper or copper alloy, means are provided to prevent the generation of galvanic currents between the iron stays or like strengthening parts and the tube-supporting plate, thus preventing corrosion.

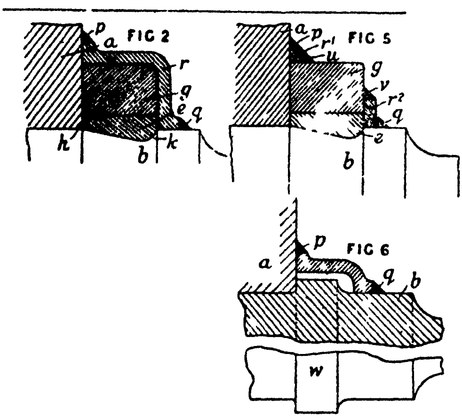
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Regeneration of Charcoal (Decolorizing Carbon), Fuller's Earth, Etc. *E. R. Bolton and E. J. Lush*, of Milner Street, London. *185,174*. May 24th, 1921.

Charcoal, fuller's earth, and like purifiers of fats and fatty oils, and nickel or other catalysts used in hydrogenating fats and fatty oils, are regenerated by treatment with superheated steam until their temperature is 230–300° C., so that the oil is hydrolyzed and glycerine and fatty acids distil over. To reduce the loss of glycerine, the steaming may commence under pressure, which may later be reduced to or below atmospheric to promote distillation. The oil-free charcoal or fuller's earth may be treated hot with air to char organic impurities, and then with steam, preferably superheated, before cooling.

Mill Rollers. *H. W. Aitken*, of 147, Bath Street, Glasgow, Scotland. *187,095*. September 5th, 1921.

According to this specification, the ends of the rollers of cane mills are hermetically sealed by means of rings at the ends of the rollers welded to the roller and to the shaft. Divided rings *e*, Fig. 2, abut at one side against the roller *a* at *h* and at the other side against a shoulder on the shaft *b* at *k*. Solid rings *g* are shrunk on to the exterior of the rings *e*, and a ring *r* welded at *p*, *q*, to the roller and shaft respectively covers in the rings *e*, *g*, and hermetically seals the end of the roller. The ring *r* may be in more than one piece, the portions being welded together at the same time as the ring is welded to the shaft and roller. In a modification, Fig. 5, the ring *r* is replaced by two rings r^1, r^2, the ring r^1 being welded at *p* to the roller and at *u* to the ring *g* while the ring r^2 is welded at *v* to the ring *g* and at *q* to the shaft *b*. Instead of providing shrunk rings at the ends of the roller, the shaft may be formed with collars *w*, Fig. 6, at the ends. The welding may be done by the oxy-acetylene or other process.



Production of Fatty Acids, Carbonic Acid and Hydrogen from Waste Cellulosic Materials (e.g., Bagasse). *Lefranc & Cie.*, 8, Place Edouard VII, Paris, France. *186,572*. February 2nd, 1922; convention date, September 26th, 1921.

Waste cellulosic materials are hydrolysed to impure sugary worts, which, after purification, are subjected to symbiotic bacterial fermentation to produce fatty acids, mainly butyric acid. Hydrolysis of the disintegrated wood waste is effected by means of dilute sulphuric acid and superheated steam; after which the acid liquors are neutralized with lime or chalk; the sugar solution is extracted from the product by exhaustion; and then it is purified from gums, resins, mucilages, &c., by adding excess of milk-of-lime, followed if necessary by passage of the decanted solution through animal charcoal. This purified wood wort is treated with the ferments obtained by inoculating sugar solutions containing mineral salts with bacilli of the intestinal digestion of herbivora, or bacilli contained in garden earth, by which means, all the reducing sugars of the wood wort are converted into acids, viz., butyric, acetic, propionic, valeric, and caproic acids. The fermented wort is concentrated to a syrup preferably *in vacuo*, and treated in a still with sulphuric or hydrochloric acid preferably sodium bisulphate to liberate the free organic acids which distil off and are fractionally separated. The carbon dioxide of the fermentation may be recovered by absorption in sodium carbonate, from which it is freed by boiling; while the hydrogen also may be collected.

MANURE CONTAINING COLLOIDAL CARBON. *J. Gradl*, of Munich, Germany. (1) *184,800.* August 15th, 1922; convention date, August 15th, 1921. (2) *185,729; addition to 184,800.* August 22nd, 1922; convention date, September 3rd, 1921.

(1) A manure consists of finely-divided or colloidal carbon or carbonized organic material in admixture with one or more oxidizers or catalysts or with both; and other manurial substances may be added. Potassium, ammonium, and other nitrates are preferably used as oxidizers; while manganese peroxide and other compounds of manganese, clay and other compounds of aluminium, magnesia and other compounds of magnesium, are the preferred catalysts. The carbon may be obtained in admixture with other manurial substances, as by treating sawdust, peat, sea-weed, "humus-lignite," or sulphite lye with sulphuric anhydride and utilizing the resulting sulphuric acid to break down raw phosphates. Manure made according to the invention may be caused to absorb liquid manures such as potash or waste sulphite lyes. In one example, wood charcoal is moistened and mixed with ammonium sulphate, ammonium nitrate being added to the mixture. In another, peat is carbonized by concentrated sulphuric acid, water added, and the product used to break up raw phosphate, manganese dioxide being finally added. In a third, peat is carbonized by sulphuric acid, which is then neutralized by the introduction of ammoniacal gas, sodium nitrate being finally added. (2) The method of making manures described in the parent Specification, is modified in that the organic materials are not carbonized. Peat, "humus-lignite," wood-flour, and algæ are mentioned as suitable materials. Other manures such as potash salts and phosphates may be added.

MANUFACTURE OF GLUCOSE (FERMENTABLE SUGARS) FROM CELLULOSE. *H. Terrisse and M. Levy*, of Geneva, Switzerland. 186,139: addition to 143,212.[1] June 20th, 1921.

Wood is first macerated with 40 per cent. hydrochloric acid, then subjected to the action of gaseous HCl under pressure, the material thus treated being carried over heated floors for the elimination of the HCl gas, which is collected, compressed, and re-used; while the wood (which is of a loose powdery texture) is boiled with water, filtered, and the resulting solution containing the "glucose" neutralized and concentrated or fermented.

PREPARATION OF PHOSPHATIC FERTILIZERS. *R. W. James*, of London (*Eisenwerk Ges. Maximilianshütte*, of Rosenberg, Bavaria, Germany). *186,223.* August 9th, 1921.

Phosphoric compounds suitable for manurial purposes such as naturally-occurring phosphates, bone meal, and phosphoric slags are converted into a form soluble in citric acid and partly soluble in citrates by intimate grinding with about one to one and a half parts of a suitable salt of the alkali or alkaline-earth metals, ammonium, or magnesium. Double salts of the alkali metals and magnesium may also be used. The sulphates, chlorides, silicates and nitrates of these metals are mentioned as suitable salts, and either the artificially-prepared compounds or the naturally-occurring varieties such as kainite, schoenite, kieserite, and carnallite may be employed. The process is stated to be of particular value in the treatment of Florida phosphates.[2]

CENTRIFUGAL. *Selden H. Hall*, of Poughkeepsie, New York. *183,133.* July 12th, 1922; convention date (U.S.A.), July 15th, 1921. (Three figures; nine claims.)

Claim 2.—In a centrifugal separator for separating a liquid from solids, the combination with a bowl having an outlet for said liquid and a separate outlet at the top for another denser liquid, of means to admit the liquid to be separated into the separating chamber of the bowl between the centre and the periphery, and means to separately admit the denser liquid to the lower part of the bowl relatively close to the periphery whereby the denser liquid will not substantially admix with the lighter liquid or require to be separated therefrom, and will flow upward along the bowl wall and outward, and carry with it the solids of the mixture that are separated by centrifugal force.

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[1] *I.S.J.*, 1920, 532.

[2] Reference has been directed by the Comptroller to Specifications 6429/06 and 151,024.

Continuous Extraction of Sugar from Beet and Cane. *Soc. Anon. Etablissements A. Olier*, of Clermont-Ferrand, France. *184,458.* July 21st, 1922; convention date, August 6th, 1921.

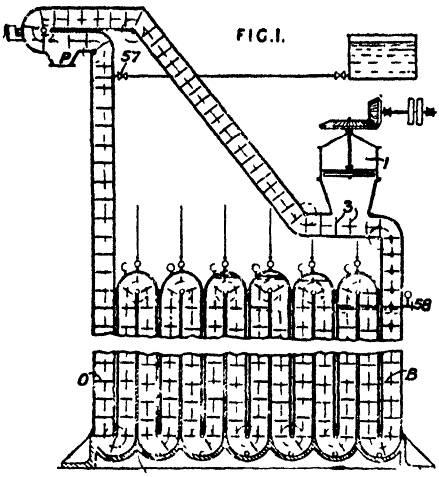


FIG. 1.

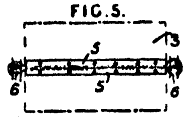


FIG. 5.

FIG. 4.

This specification describes an apparatus for extracting juice from the beet or cane by the diffusion process. It consists of a closed conduit through which the material to be treated is carried in counter-current to the extracting liquid by an endless conveyor provided with perforated plates and buckets. In the drawing shown, the material passes from a cutter *1* to the conveyor which carries it through a series of parallel channels *B* . . . *O* to an outlet *P*. Some or all of the partitions separating the channels *B* . . . *O* are hollow for the circulation of heating liquid. Extracting liquid enters by the cock *57* and leaves through the cock *58*. The conveyor is formed of perforated plates *3* carried on endless cables *4*. The plates are attached to the cables by means of angle-irons *5*, (Figs. 4 and 5), riveted to the plates. One flange of each angle-iron is cut away at the ends and the other flange is bent round blocks *6* made in two halves and attached to the cables *4* by screws.

Production of Barium Hydrate (for the Extraction of Sugar from Beet Molasses). *Camille Deguide*, of Outreau, Pas-de-Calais, France. (1) *110,537.* July 10th, 1917. (2) *174,052.* January 13th, 1921.

(1) Barium hydrate for use in the baryta process of extracting sugar from beet molasses[1] has hitherto been obtained by the decomposition of the carbonate by heat at 1400–1500° C., that is a temperature at which the BaO fuses; and the great disadvantage of this method of working is that, in order to lessen the corrosion action of the alkali earth, the decomposition must be effected in special rather costly crucibles, which nevertheless are liable to much deterioration. Another method of manufacturing barium hydrate is to heat a mixture of barium carbonate and carbon, but in this case the reaction is always incomplete. These defects are avoided in the new process now exposed. It consists in the production of di-barium silicate by intimately mixing together finely ground silica and barium carbonate using the proportions of 60 and 394 parts by weight respectively, and heating the mixture to about 1400–1500° C. in a rotary furnace (such as is used in the manufacture of cement), the product being granular. On mixing this di-barium silicate with water, barium hydrate and mono-barium silicate are formed, the latter being practically insoluble, and capable of easy separation by subsiding. It is mixed with barium carbonate in the proportions of 213 and 197 parts by weight respectively, and this preparation after being again heated in the rotary furnace to the temperature previously named yields a further quantity of di-barium silicate, which again is decomposed with water with the formation of barium hydrate and mono-barium silicate, so that the process is a continuous one. (2) In this second specification, the inventor states that he has found an improved yield can be obtained by forming the tri-barium

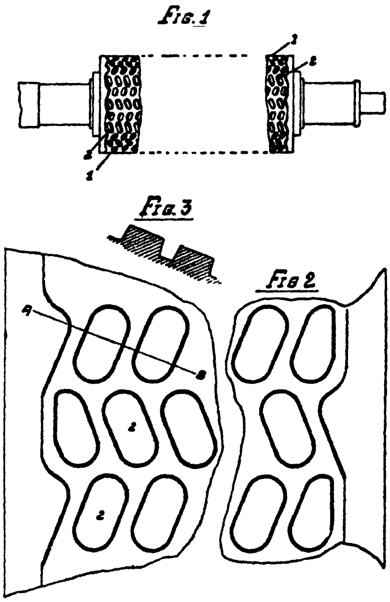
[1] See *I.S.J.*, 1922, 494.

silicate (instead of the di-barium silicate) and decomposing with water as before; or he may produce an intermediate stage between the di and tri-barium compounds. Although the tri-barium silicate is more readily fusible than the di-barium compound, yet it is sufficiently infusible at the temperature at which barium carbonate decomposes for the process to be operated industrially without difficulty, using as before a rotary furnace. However, it is not possible further to increase the proportion of barium carbonate, since the formation of the tri-barium compound appears to be the maximum that can be applied without trouble as the result of fusion being caused.

HOLLAND.

CRUSHER ROLL FOR CANE MILLS. *N. V. Machinenfabriek Bratt*, of Soerabaja, Java. 4947. May 15th, 1920.

According to this invention, the surface of the crusher roll is provided with raised figures placed in a zig-zag fashion, as in the case of two other patents mentioned.[1] In this specification, however, the figures are in the form of a block with rounded edges; and the invention is characterized by the longitudinal axis of each of the figures making the same angle with a line running parallel to the axis of the roller, and also by the figures arranged in rows running lengthwise being directly opposite those of the alternate series; so that, regarded in the direction of the circumference, twisted or serpentine grooves are formed; while, regarded in the direction of the axis, straight ones are produced. By means of this construction (it is explained), the bagasse fastens into the grooves, any slipping being prevented both by the serpentine and also by the straight grooves. As soon as the pressure is removed by the further revolution of the roll, the bagasse falls away from the ridges, but that in the grooves remains to meet again the material undergoing crushing. This bagasse retained in the grooves forms (it is here said) a rough surface whereby the cane is easily retained, and slipping is prevented. Turning to the illustrations, Fig. 1 shows a view of the roll according to this invention; Fig. 2 is a top view of a portion of the surface on an enlarged scale; and Fig. 3 is a section of two adjacent raised figures taken along the line *A—B* of Fig. 2. Fig. 1 represents the surface of the crusher roll, upon which in the direction of a line running parallel to the axis of the roll raised oblong figures *2* are arranged at determined intervals, these being set at an angle to the said line running parallel to the axis of the roll. Each of these raised figures has in section almost the form of a trapezium, being broader at its base, as may be seen in Fig. 3, and therefore stronger. In Fig. 2 the arrangement is shown which best deserves preference. Here the raised figures are about 30 to 50 mm. (1 $\frac{3}{16}$ to 2 in.) broad, measured along their top surface; their corners are fully rounded; while they are so placed that their longitudinal axis forms angles of 76½ and 112½° with the line running parallel to the axis of the roll. Measured in the direction of their longitudinal axis, the distance between alternate figures may vary between 50 and 70 mm. (2 to 2¾ in.).



[1] French patent, 376,675; and British patent 7562 of 1908.

UNITED STATES.

APPARATUS FOR THE DISTILLATION OF ALCOHOL. *Ernest J. Winter* (assignor to *U.S. Industrial Alcohol Co.,* of West Virginia, U.S.A.). (1) *1,427,885.* (2) *1,427,886.* (3) *1,427,887.* (4) *1,427,888.* September 5th, 1922.

(1) Claim 1.—A process of rectifying alcohol, comprising distilling aqueous alcohol, passing the vapours through long tubes maintained under a vacuum and at a temperature below the boiling point of absolute alcohol corresponding to the low pressure used, and condensing the alcohol issuing from the tops of the tubes. (2) Claim 1.—An apparatus comprising the combination of a still, a rectifier containing long tubes, means for keeping the latter at a predetermined temperature, a condenser and a vacuum pipe connected thereto. (3) Claim 30.—The combination with a source of mixed vapours, of separating means comprising a tortuous path through which vapours may be evacuated, an unobstructed path through which a condensate may descend, and also means external to said separating means for the refractionation of the resultant products in inter-connected regions of a column rectifier whose vapour outlet is maintained under a reduced pressure. (4) Claim 5.—The process which comprises distilling alcohol having a strength of 20 per cent. or lower, bringing into contact relatively moving bodies of mixed liquid, alcohol, and water condensed from the distilled vapours and said vapours under decreased pressure, then removing the liquids, treating them in the lower portion of a column rectifier, condensing the mixed vapours and treating them in the upper portion of the column rectifier.

DISTILLING AND RECTIFYING COLUMN. *E. A. Barbet,* of Paris. *1,427,430.* August 29th, 1922. (Four claims.)

Claim 1.—An improved column plate for distilling and rectifying apparatus, comprising a plate, a plurality of parallel elevations extending substantially across the plate, chimneys extending from the plate between said elevations to a point above the level of the elevation, elongated hoods arranged over the chimneys in each of the portions of the plate between said elevations, perforated plates connecting adjacent hoods resting on the elevations, and cooling coils on the perforated plates.

OBTAINING SUGARS FROM SUBSTANCES CONTAINING CELLULOSE. *Alex. Classen,* of Aachen, Germany (assignor to *The Chemical Foundation Inc.,* of Delaware, U.S.A.). *1,428,217.* September 5th, 1922.

Claim 1.—A process for converting cellulose-containing substances into sugars, which consists in mixing about 1000 parts of the cellulose-containing material with about 880 of water, about 10 of hydrogen chloride, about 2 of hydrogen sulphate, and 1 of sulphur dioxide, and then heating.

MANUFACTURE OF GRAPE SUGAR (DEXTROSE OR GLUCOSE). *Paul W. Allen,* of Cedar Rapids, Iowa (assignor to *Penick & Ford, Ltd.,* of Delaware, U.S.A.). *1,422,328* July 11th, 1922. (Four figures; five claims.)

In accordance with the present invention, the starch in admixture with water is converted into sugar in any suitable manner, the starch being treated prior to conversion, to eliminate the residual protein substances contained ordinarily in commercial starches. This purifying treatment is preferably that given in LENDERS and ALLEN's application[1], consisting in the liquefaction of the protein by the action of proteolytic bacteria and the removal of the liquefied substances. After the starch has been purified in this manner, the liquor is next concentrated to a rather thick syrup, and is beaten while still hot to a porous, frothy consistency resembling whipped cream. The sugar is allowed to harden and crystallize while in this state, the product being a hard but white porous cake, which may (if desired) be reduced to a very fine, dry powder that will retain its dryness. Sugars manufactured by this method will be white in colour, and will be free from the bitter taste frequently possessed by grape sugar made from corn starch.

[1] Serial No. 263,026; November 18th, 1918. U.K. Patent, 149,374; *I.S.J.*, 1920, 712.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending December 31st.		Twelve Months ending December 31st.	
	1921. Tons.	1922. Tons.	1921. Tons.	1922. Tons.
Unrefined Sugars.				
Poland	....	....	5,641	107
Germany	....	....	...	60
Netherlands	....	....	398	545
Belgium	....	....	. ..	...
France	....	. ..	....	....
Czecho-Slovakia		....		...
Java	102	477	25,556	164,791
Philippine Islands	....	....	....	....
Cuba	43,942	7	260,155	631,995
Dutch Guiana	1,090	499	2,714	3,893
Hayti and San Domingo	....	....	....	....
Mexico	..	....	..	....
Peru	5,510	19,641	74,067	102,331
Brazil	11,702	16,147	80,714	112,944
Mauritius	....	21,784	184,683	194,581
British India	....	....	1,423	2,069
Straits Settlements	....	...	....	....
British West Indies, British Guiana & British Honduras	7,473	1,814	110,282	96,903
Other Countries	16,975	4,020	69,203	86,358
Total Raw Sugars	**86,793**	**64,389**	**814,838**	**1,396,577**
Refined Sugars.				
Germany	....	60	1	154
Netherlands	4,455	8,000	91,261	57,360
Belgium	6,566	10,499	42,360	35,058
France	....	696	3,058	7,108
Czecho-Slovakia	13,526	20,068	99,565	49,265
Java	1	417	4,825	11,275
United States of America	3,054	2,136	171,534	270,455
Argentine Republic	....	...	....	....
Mauritius		. ..	...	....
Other Countries	1,682	4,672	55,557	102,642
Total Refined Sugars	**29,284**	**46,550**	**468,162**	**533,317**
Molasses	7,107	23,319	94,618	122,864
Total Imports	**123,184**	**134,258**	**1,377,618**	**2,052,758**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
British Refined Sugars.				
Denmark	16	196	34	2,322
Netherlands	273	151	2,296	3,312
Channel Islands	50	37	1,331	1,020
Canada	....	....	....	8
Other Countries	523	408	3,442	22,484
	862	792	7,102	29,156
Foreign & Colonial Sugars.				
Refined and Candy	338	147	801	5,265
Unrefined	343	811	3,310	9,427
Various Mixed in Bond	....	....	....	....
Molasses	483	379	812	3,505
Total Exports	**2,026**	**2,129**	**12,025**	**47,353**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.		1921. Tons.
Total Receipts, January 1st to December 27th	3,618,394	..	2,537,416
Deliveries ,, ,, ...	3,618,394	..	2,548,468
Meltings by Refiners ,, ,, ...	3,587,636	..	2,542,194
Exports of Refined ,, ,, ...	808,000	..	373,000
Importers' Stocks, December 27th	—	..	—
Total Stocks, December 27th	28,836	..	35,131
	1921.		1920.
Total Consumption for twelve months	4,107,328	..	4,084,672

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1919-1920, 1920-1921, AND 1921-1922.

(Tons of 2,240 lbs.)	1919-20. Tons.		1920-21 Tons		1921-22 Tons.
Exports	3,251,271	..	2,104,224	..	3,594,173
Stocks	293,674	..	1,152,222	..	223,397
	3,544,945		3,256,446		3,817,570
Local Consumption	79,700	..	105,000	..	125,000
Receipts at Ports to October 31st..	3,624,645		3,361,446		3,942,570

Havana, October 31st, 1922. J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWELVE MONTHS ENDING DECEMBER 31ST, 1920, 1921, AND 1922.

IMPORTS.	1920. Tons.		1921 Tons		1922. Tons.
Refined......	119,812	..	468,162	..	533,317
Raw	1,251,544	..	814,838	.	1,396,577
Molasses	74,557	..	94,618	..	122,864
	1,445,913		1,377,618		2,052,758

EXPORTS	1920. Tons.		1921. Tons.		1922. Tons.
Refined..	6,437	..	801	..	5,265
Raw....... ...	9,929	..	3,310	..	9,427
Molasses	3,740	..	812	..	3,505
	20,106		4,923		18,197

HOME CONSUMPTION.

	1920. Tons		1921. Tons.		1922. Tons.
Refined	139,622	..	469,362	..	498,988
Refined (in Bond) in the United Kingdom	785,140	..	787,572	..	937,579
Raw	181,240	..	131,966	..	168,073
Total of Sugar	1,106,002		1,388,900		1,604,640
Molasses..	27,144	..	10,991	..	10,223
Molasses, manufactured (in Bond) in United Kingdom ..	67,927	..	47,539	..	52,090
	1,201,073		1,447,430		1,666,953

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT DECEMBER 31ST, 1920, 1921, AND 1922.

	1920. Tons.		1921. Tons.		1922. Tons.
Refined in Bond	27,750	..	28,350	..	57,200
Foreign Refined	29,200	..	17,650	..	38,150
,, Unrefined..	332,400	..	125,200	..	219,250
	389,350		171,200		314,600

Sugar Market Report.

Our last report was dated 7th December, 1922.

Since that date we have experienced a moderately fluctuating market, values showing no great change on balance. The speculative sentiment alluded to in our last report has subsided and given place to a more reserved attitude; there is now a tendency to await the development of the situation under the influence of full supplies from Cuba. The firm tone last reported in our terminal market continued for some few days, carrying the value of May delivery to 22s. 9d. From this point a sharp reaction took the price to 22/1½, from which it quickly recovered to 22s. 6d. Since the turn of the year, advices from New York have influenced a quieter tone here, and once again the value of May has receded to about 22s. 1½d. We now quote:—January 21s. 6d., May 22s. 1½d., August 22s. 3d.

Trading in actual sugars, which remained brisk—at any rate so far as near deliveries were concerned—until interrupted by the approach of the Christmas vacation, has been on a moderate scale since the market reopened in the New Year. London Refined quotations were reduced on the 9th instant by 6d. for Prompt sugars, making a decline of totally 1s. per cwt. since we last wrote. Present quotations are:—No. 1 Cubes 55s., London Granulated 49s. 6d. duty paid. Towards the middle of December offerings of American Granulated came more into line with current values on this side, assisted by the rise in the dollar exchange, and business was done at 23s. c.i.f. U.K. for Feb./March shipment. First-hand quotations were subsequently advanced to the neighbourhood of 23s. 9d. to 24s., but again within the past few days business is reported at 23s. to 22s. 9d. The present quotation for February/March shipment is 23s. c.i.f. U.K.

Czecho-Slovak sugars remain in short supply. The refiners generally offer forward very sparingly, and are evidently awaiting developments. Meantime the volume of second-hand transactions has dwindled to small proportions, supplies of some brands having become almost completely absorbed. Czecho-Slovak Fine Granulated has changed hands at from 22s. to 21s. 7½d. (according to brand), ready, f.o.b. Hamburg.

Belgian Granulated is quoted at 21s. 9d. to 21s. 6d. f.o.b. Jan. and 22s. Jan./March, and Dutch Granulated at 22s. 4½d. to 21s. 10½d. (according to brand), prompt, f.o.b.

With the demand for Refined in America slackening off, and refiners consequently able to hold off the market to some extent, the difficult period between the completion of the old Cuban crop and the coming to hand of the new has been passed without undue stringency, in spite of the low figure to which the Cuban-American stock had ebbed. 4 cents cost and freight New York remains the top price touched for Cuban Centrifugals. Under the influence of freer offerings of new crop sugars on the more distant positions, the value of Prompt sugar receded during the latter part of December to 3¾ cents, from which point it improved temporarily to 3⅞ cents, only to sink again to 3⅝, at which the last business is reported to have taken place. January shipment is quoted at 3 9/16 cents and February shipment at 3½ cents, cost and freight New York.

First official estimates of the new Cuban crop are as follows:—

	Tons.
Willett & Gray	4,000,000
Guma/Mejer	4,193,500
Himeley	4,102,857

and the two latter are generally regarded as approximately summing up present probabilities. Unfavourable weather immediately preceding an early commencement of grinding has resulted in reports of a poor yield from some Centrals, but later advices speak of improved weather conditions and forecast a generally satisfactory progress of operations.

The Java market is reported firm with buyers of Whites for January/February at 13¾ guilders first cost, and sellers reserved.

India has shown more disposition to enter the market, and a fair business is reported to have been done lately in White Javas for January shipment up to 20s. 9d. and Feb./March shipment to 20s. 10½d. cost and freight Calcutta basis. Exports from Java during December amounted to 103,000 tons. The total stock at the end of December is estimated at 465,000 tons.

10 & 11, Mincing Lane,
London, E.C. 3,
11th January, 1923.

H. H. Hancock & Co.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

West Indian Claims for Relief.

A well-informed correspondent writes to us that the approaching Budget is a source of considerable anxiety to Colonial sugar producers who market their product in the United Kingdom, as it is quite on the cards that a reduction of the heavy duty may be made. If 1d. per lb.—a likely amount—were taken off the present 2¾d. duty (which would mean, it may be pointed out, on last year's consumption a loss to the Exchequer of fourteen million pounds sterling) it would have the effect of reducing the value of the British preference from £3 15s. per ton in the case of 96° sugars and £4 5s. per ton in the case of white sugars to £2 8s. and £2 14s. respectively. The British West Indian planters especially view the contingency with apprehension, inasmuch as their principal sugar is 96° refining crystals that enter into direct competition with those of Cuba, which (as the latter country now sets the price of the western world's sugar and produces its sugar under conditions which enable an especially low cost to be possible) renders a considerable amount of protection for their sugars essential to the maintenance of their industry. What the British West Indian planter desires and considers due to him is that the protection given his sugar in the Mother country should be based on that which the United States gives its sugar in respect to that of Cuba, viz., £8 4s. per ton for 96° sugar. This would be nearly afforded—with the present duty—by an increase in the preferential rate from one-sixth to one-third, giving a preferential value of £7 10s. per ton. As a safeguard in the event of a reduction of duty he also considers that the present value, £3 15s. per ton, of the preference should be guaranteed to him for a term of years. These in effect will probably be the terms for which the British West Indian planters will agitate in respect of the next Budget.

Whether the Government will ever be disposed to concede so large a preference appears to us another matter. The Government certainly realizes that it is of the highest importance not to let the production of sugar in the Empire be crushed out by Cuban or other competition, and there is the fact that the West Indian production is on the small side—that of the Islands put together is but little more than the output of one factory in Cuba, to wit Delicias, while that of British Guiana is

only 100,000 tons—hence the loss to the Exchequer from this source by a further concession of preference would not be very marked. It would, however, be practically doubled by reason of the Mauritius and surplus Natal sugar, and unless there is some substantial prospect of this extra preference doing something more than keep the existing West Indian sugar production in *status quo*, unless it promises to stimulate the colonial sugar industry to extend its output very considerably, so as to provide the Mother country with a much larger proportion of British grown sugar, there will be a considerable weight of opinion at home averse to giving the colonies a further rebate at the expense for the time being of the home revenue. The broader aspect of the case is of course that a subsidizing of the colonial sugar industry is an insurance against any foreign source being able to monopolize the sugar supply needed by this country and so be in a position to dictate prices. But when a big insurance premium is demanded it is necessary to ascertain whether there are funds wherewith to meet a possible claim. The "funds" in the case of the British West Indies are their potential output of sugar, and though high figures have been put forward by interested associations as representing what the British West Indian colonies are really capable of, there have been too many "ifs" to make it a matter of certainty that the granting of a big preference such as is suggested above would be followed by the "cubanizing" (if we may coin such a word to represent the Cuban rate of sugar development) of the British West Indian cane-growing areas, actual and potential. Personally we think the experiment is worth trying, but we are not blind to the fact that there are others who are of a different opinion. We would also point out to the West Indian planter that in the event of his preferential views being accepted by the Government, there are other portions of the British Empire which might eventually avail themselves of the preference and develop more successfully a bigger sugar production than the British West Indies may conceivably do, in which case the result to the West Indian planters would be increased competition on level fiscal terms. Whether, then, the Empire sugar preference is increased or remains under guarantee at its present value, the necessity for the British West Indian sugar producers working out their own salvation by progressive methods and increasing energy appears to be unabated.

The Coming Budget.

It is not however certain that the Government will find themselves in a position this year to vary the terms of the preference to British sugar. The claim of the latter is only one amongst many that the Chancellor of the Exchequer is being pressed to meet in the interests of trade revival and it has been pointed out that if all the claims put forward recently were acceded to, revenue would fall far below expenditure. Amongst them are Income Tax which is assuredly too high, and the Corporation Tax which is an extra impost falling on ordinary shareholders of limited companies and has strong grounds for securing abolition; while as for the indirect system of taxation, to which sugar belongs, the claimants for a reduction in the beer duty, for example, are a strong party and will probably be among the first to receive concessions. From the consumer's point of view sugar has of course strong claims too, and, as we have argued on another occasion, any reduction in the duty on sugar would tend to increase our consumption which is considerably below that of several other countries—e.g., the United States, Canada, Australia and even Denmark—but we rather anticipate that the Government will in the end leave the sugar duty and preference as they are for another year rather than lose revenue not only from a reduced duty on foreign sugar but

also from an increased reduction on British sugar; for we do not suppose they will decide to reduce the duty and just leave the preference to operate on the old basis of one-sixth off. This would be the unkindest cut of all to the British sugar producers.

The United Kingdom Consumption for 1922.

The Board of Trade figures published in our last issue[1] showed that the consumption of sugar in the United Kingdom for the twelve months ending December 31st last amounted to practically 1,604,640 tons. We say *practically* advisedly, because there is at times a certain amount of sugar exported with rebate of duty, which, hence, should be deducted from the amount shown as going into consumption, but as a rule the vast bulk of the exports are from bond and so have not been previously entered as going into consumption. For the first six months of 1922 98·8 per cent. of the exports was from bond, the trifling balance being exported with rebate from the "consumption" quota. The Board of Trade figures as published do not distinguish the two classes of export, so it is left to be surmised from the above data that the figures given as the consumption for the year 1922 are only an inappreciable fraction above the net amount entering into consumption.

Taking the population at 47,157,750, this is equivalent to 76·22 lbs. per head, which compares with 65·63 lbs. in 1921, 52·53 lbs. in 1920, and 72·70 lbs. in 1919. It is of course a long way behind the U.S. consumption which was, as is shown below, no less than 103·18 lbs. in 1922 and 84·47 lbs. in 1921. But considering our heavy duty on sugar and the fact that we are still a "wet" nation, and also on account of the still heavy percentage of unemployment existing in this country, the United Kingdom per capita consumption for 1922 must be considered very satisfactory. If trade revives during the next twelve months, as it is expected to do more or less, this should raise the figures for 1923; any reduction in the sugar duty would of course have a marked effect in the same direction.

The American Sugar Consumption, 1922.

The consumption of sugar in the United States for the calendar year 1922, was, according to WILLETT & GRAY, 5,092,758 long tons refined or consumption value. This figure breaks all previous records, being an increase over the previous year of nearly one million tons (i.e., 24 per cent.) which compares wtth an average increase for one hundred years of 5·403 per cent. This raises the per capita consumption likewise to the largest on record, being 103·18 lbs. as compared with 84·47 lbs. in 1921.

Opinion in statistical quarters in the United States is agreed that this big jump in consumption is due to the low price of sugar prevailing during the first part of 1922, when for the first six months the consumption was 2,781,218 tons or at the rate of 5,562,436 tons per annum. Frequently in the States Spring booms have been followed by an Autumn slump, but in 1922 the second half of the year did not witness the usual retrogression, so that the total for the year was higher than might have been expected. Although the invisible supplies are not known the bulk of opinion seems to assume that they are not appreciably higher than the average of recent years. If it is a correct supposition that practically all the sugar has gone into consumption, the latter must be considered an indication of the general business prosperity of the United States and the better employment of labour at good wages. But at least one market organ, the *Federal Reporter*, dissents from this view, and we quote its opinion below.

[1] *I.S.J.*, 1923, page 55.

Of the five million odd tons, 2,164,821 tons are ascribed by WILLETT & GRAY to Domestic sugar sources, 2,890,571 tons to Cuban cane, and 37,366 tons were foreign sugars. The total of refined sugar consumed was 4,899,553 tons while 193,205 tons are described as "raw or plantation state" sugars.

Incidentally, the year 1922 showed a record for exports, 725,000 tons of refined being shipped from Atlantic ports, as compared with 373,256 tons in 1921.

Distribution or Consumption.

The *Federal Reporter*'s view of the situation is that this record "consumption" should be more accurately described as "distribution." They write: "We feel that these figures should be more properly called distribution rather than consumption. From all past experience, when invisible supplies have been practically consumed, as was the case at the opening of 1922, the demand usually exceeds consumption, especially if prices are low and, like those ruling during the early part of last year, below the cost of production. Coupled with the low prices which brought increased distribution, was the speculative movement of the last quarter of 1922, which also stimulated purchasing. We, therefore, are of the opinion that, due to the above, invisible supplies have been replenished to the extent of at least 300/500,000 tons, and feel that especially at to-day's high prices the distribution of 1923 will fail to equal that of 1922. Present indications and the fact that the trade are buying only sparingly would seem to confirm this belief."

Home-Grown Sugar.

The Kelham factory of Home Grown Sugar, Ltd., having been unable to operate during the 1922-23 campaign for reasons which have already been indicated in these columns, arrangements were made for the roots which had been grown in both areas to be worked at the Cantley factory of the English Beet Sugar Corporation, Ltd., the total amount being 54,000 tons.

It is a matter of congratulation that the actual extraction of white sugar has now for the first time in England reached 13 per cent., which compares more favourably with the experience in foreign countries. The average sucrose content of the beets was between 16 and 16½ per cent., which, it is interesting to note, is not only a satisfactory percentage, but was secured during an exceptionally sunny but dry summer in 1921 and an exceptionally wet summer, with an extraordinary lack of sunshine, in 1922. The price given for these roots was 32s. per ton free on rail, on a 15½ per cent. sugar content basis, but as prices varied by 1s. per ton for each ½ per cent. above and below that figure, the actual cost delivered to the Cantley factory, including transport, amounted to between 42s. and 43s. per ton. We do not know the exact cost of manufacture in these British factories, which must obviously be comparatively heavy during the experimental stages of the industry, but as the price of refined granulated sugar has been £48 per ton and it has had the advantage of the remission of Excise duty, there is no reason to doubt that after many years of disappointment the industry has had a chance, for the first time, to yield a satisfactory profit.

In view of this first favourable experience, it is not surprising that active preparations are being completed to extend the operations during 1923. We understand that Kelham is to re-open for this campaign and will deal with 50,000 tons of roots from 6000 acres of land, while the capacity of its factory is to be extended from 500 to 700 tons of roots per day. Cantley, thanks to the experience gained last season, has been able to offer the farmers improved terms that have

resulted in an offer of 9000 acres within a few weeks, and possibly double that acreage might have been forthcoming if the factory could have seen its way to deal with such a crop. The new contract provides a standard price of 40s. per ton delivered at the factory, while a sliding scale provides an extra shilling per ton for every shilling by which the price of refined sugar exceeds 40s. per cwt. and a bonus of 2s. 6d. per ton for each 1 per cent. of sugar content over 15½ per cent. On the basis of last season's figures of sugar price and sugar content (49s. and 16·2 per cent.), the farmers this year may count on 51s. per ton of delivered roots instead of 42s. This of course assumes that the sugar price does not fall and that also the Budget discloses no reduction in the sugar duty; ¾d. off that duty would in itself reduce the farmer's payment by 7s. 6d. per ton of roots. Kelham, it may be added, has issued an identical contract to its growers.

It is natural for success to be achieved when there is so big a preference on the sugar as £25 per ton; but it is more important to achieve results amongst the farmers, to whom, in view of the present depression in agriculture, the beet crop this last year was found to be of great assistance, and if these can be led to cultivate each year increasingly large areas in sugar beets, they may learn to appreciate the advantages of including this crop in their farm rotation apart from any direct benefit from the sale of the crop itself. Once this point is firmly grasped there would be more certain tenure for beets on English farm land, and the factories already erected and those to follow would have a correspondingly assured position in English manufacturing industries, even when, as is bound to come some day, the disparity between Excise and Customs duty on sugar is considerably less than the figure at present allowed, which latter is avowedly for experimental purposes.

Sugar Production in China.

The production of sugar in China, says a Department of Overseas Trade Report from H.M. Legation, Peking, has been on the decline for many years, and no really serious effort has been made to establish a modern sugar cane industry. Whatever efforts have been made in this direction have been negatived by the adulteration practices of the sugar merchants and the difficulty of obtaining regular supplies of cane. The Chinese have, consequently, learnt to use largely foreign sugar, even if they have to pay more for it. China is estimated to produce 450,000 tons of sugar, and to import 350,000 tons, making an annual consumption of some 800,000 tons, or 4 lbs. a head. The success of the British sugar refineries at Hong Kong is now said to have inspired the Chinese to have a refinery of their own in Chinese territory outside the foreign settlements at Shanghai. The company, which is to be promoted as a patriotic venture, owes its origin to the head of the largest and most successful Chinese confectionery business, a firm whose products are gradually displacing imported biscuits and confectionery for native consumption, and calls for a capital of $5,000,000.

The planting of sugar beet in China, though common in many regions, especially Manchuria, has hitherto proved a failure owing to the short season between the hot summer and cold winter. Experiments are, however, now being conducted in Shantung and other provinces in an attempt to discover a remedy. Sugar beet factories have been established and are in course of erection in Shantung and Manchuria.

Fifty Years Ago.

From the "Sugar Cane," February, 1873.

In this issue of our predecessor there appeared an article which gave a fairly full account of what was known of the application of animal charcoal half a century ago. A perusal of this statement of the knowledge of the subject at that time leads one to remark that the general principle of the apparatus (filters, cisterns and kilns) in use at the present day remains the same as it was then, though of course it has been very greatly improved in mechanical detail. As to the theory of the action of char in removing colouring matter and salts from solution, little could be said at that period, and indeed little more of importance can now be offered in explanation, though it will be seen that the following extract from the article contains a vague suggestion of the "power" termed adsorption in our own day: "It is not known in what exact way the carbon acts upon the colouring matter which it extracts. Whether it simply detains it mechanically, or combines with it chemically, or has the property of condensing it upon its surface or within its pores, in the way in which spongy platinum acts in absorbing gas, is uncertain, though it is probable that some power is present over and above that of mere mechanical detention . . . ." Regarding the method of revivifying the char, kilning was most generally applied, often preceded by a fermentation process; though in this article a description was given of Eisfeld's process, according to which the spent material was subjected to fermentation, and then treated successively with hydrochloric acid, steam, and ammonia, without being re-burned.

Mr. ALFRED FRYER, the Editor of the *Sugar Cane*, continued his series of contributions on "The Influence of Forests on Rainfall," and in this issue dealt with the question as affecting Mauritius, quotations being given from a number of articles by various writers. Schemes had been discussed by the HON. L. ARNAUD, Mr. P. E. DE CHAZAL, and Mr. DUNCAN for the replanting of the hills and waste lands of the island, and the last-named gave a list of indigenous trees and shrubs which he considered should be cultivated. Another writer (an anonymous one) called attention to the fact that the destruction of timber was being carried on "with extraordinary activity," and he advocated the formation of Woods and Forests laws, adding that he was "well aware the question is one of great difficulty to legislate upon, still, why allow less important questions to take precedence of this one, on which hinges so much the future prosperity of the colony?" Examples were given of the effect of forests on the rainfall in different countries, and in regard to Dominica, the statement was made that "the great abundance of trees must be the chief reason why the island is visited with heavy rains . . . ."

A method of clarification was described by M. CLERC,[1] according to which juices and syrups were treated with a solution of barium chloride, to which had previously been added an extract of tannin, the amount of barium salt being sufficient to precipitate the sulphates present. Another process protected by CUNISSET and CARRIÈRE[2] actually involved the use of carbolic acid; while in regard to mechanical devices inventions were noticed by PORION and MEHAY[3] for the treatment of saccharine liquid by an exosmose apparatus; by LANGEN[4] for improvements in the manufacture of loaf sugar; and by MATROT[5] for a char revivifying kiln with vertical retorts.

[1] French Patent, 95,965. [2] F. P., 96,302. [3] F. P., 95,888. [4] F. P., 96,174. [5] F. P., 96,277.

The Economics of Hawaiian Sugar Estates.

In considering the Report of the Committee in charge of the Experiment Stations of the Hawaiian Sugar Planters' Association last year,[1] we pointed out that the immediate effect of the period of depression through which the industry has recently passed was to stimulate the work on experimentation. While closely scrutinizing all expenditure and making all savings possible, there was no suspicion of any tendency to close down or even hamper any line of work which evidenced real possibilities; and, while certain minor investigations have been temporarily shelved, the situation is being met by increased intensiveness in research in all the major projects which have been inaugurated by the Association. This fact alone, if any were needed, would demonstrate the much greater utility of important industries having their own departments of research, instead of depending, as is practically universal, for instance, in the British Colonies, on financial support from the Government, which is solely harassed for the moment in finding the means for keeping up the administration itself. Every penny is more likely to be used to the utmost possible advantage, and the officers in charge of the research are not only freed from inconsiderate and often largely political criticism, but are usually given a much freer hand in their work, and thus stimulated to greater exertions. The year's working in Hawaii, while fully maintaining its usual high level in research, shows an economy of something like $18,000.

A review is offered of the work done down to the 30th of September, 1922, and steady progress is shown all along the line. The Director, H. P. Agee, gives interesting details of the various activities in his department, quoting freely from the summaries provided by the various expert officers on the staff. It is impossible here to refer to all the kinds of work being carried on, and, as was done in our last year's review, we have been compelled to make a selection, and have chosen a study of the extraordinarily high yields of sugar which have for so long been a characteristic of the Hawaii sugar industry, and how these have been obtained.

A somewhat detailed treatment is accorded in the Report to the interesting experiments in increasing the yields of sugar on the Waipio Experimental Station under the charge of J. A. Verret. It will be recalled that, in last year's Report, it was stated that, on 17 acres of the station, 15·87 tons of sugar were obtained on the two years' crop. It is now mentioned that 13–14 tons have become a routine procedure. The yield of 15·87 tons from the plant canes was not repeated in the first ratoons, which produced only 14·88 tons of sugar per acre. If, however, we consider the time during which these ratoons were in the ground, and thus judge the yield by including both the time and area factors, the condition is reversed; for the ratoon crop produced 0·650 tons of sugar per acre–month as against only 0·622 by the plant canes. This method of calculating the yield is developed in a consideration of a small field of H 109 canes for the last four seasons, during the years 1918-1922. The results are summarized in the following Table, which shows, incidentally, how well this variety behaves on ratooning under heavy crop conditions.

Year of crop.	Character.	Months in ground.	Sugar in tons per Acre-month.	Acre-year.	Acre-2 year.
1918	Plant canes	15½	0·383	4·596	9·192
1919	First ratoons	11½	0·513	6·156	12·312
1921	Second ratoons	21½	0·575	6·900	13·800
1922	Third ratoons	15	0·630	7·560	15·120

[1] *I.S.J.*, 1922, p. 66.

The Director believes that the development of the field methods adopted at Waipio would not have been feasible without this basal standard of comparison, and it is important to note that two plantations have during the year adopted the acre-month system. The Station is working towards a reduction in the cropping period from 24 months towards 15-20 months, or rather an alternation of, say, 14-16 and 17-20, and it considered that the limit of production has probably not yet been reached. It is of special importance to note that these high yields have not been reached by higher cost per ton in water or labour, in fact a distinct economy has been effected in both of these expensive factors of production. In conclusion, it is pointed out that these yields are not merely those of an experiment station, where the economics of plantation work are so difficult to gauge, but that yields of over 15 tons of sugar have been obtained, by working on similar lines, in several fields of the Ewa Plantation Co. during the past year, showing that, where the climate is suitable, a high yield of sugar is also practicable under estate conditions.

With these facts before him, the Director elaborates a discussion on the essential factors which govern the production of sugar in Hawaii. He points out that, somewhere about 1907, the area under sugar cane in the islands became more or less constant at a figure of about 200,000 acres, the reaped crops being from a little over half that area. He divides the period since that time into three five-year sections as follows:—During 1907-11 the area cropped was 106,093 acres, during 1912-16 114,144, and during 1917-1921 119,120. The actual production in the different sections of the islands is shown in a table, from which we see that there had been no material advance in the total amount of sugar produced. In spite of a continued increase in the knowledge of sugar production, the outturn has been merely maintained, but this AGEE regards as a source of gratification, for there has been a gradual and adverse change in labour conditions, entailing longer growing seasons, together with a change in the varieties grown, besides which it must be remembered that the cultivation is a one-crop one without any form of rotation.

He points out that the essential factors of production are not yet fully understood, and especially in regard to their relation to one another. These factors he summarizes as land, labour, water, manure and climate, and states that it is not yet known in most cases at what point any factor may reach the limiting stage, and thus render nugatory all improvements effected in the others. In order to gain precision the following units are adopted:—Acres of land, man-days of labour, millions of gallons of water, lbs. of nitrogen applied, and months of growing time. To indicate the kind of investigation that is required for increasing production, a field is considered where 1 acre is worked by 75 man-days, uses 5,000,000 galls. of water and 125 lbs. of nitrogen, and produces 5 tons of sugar per crop (of two years). Labour is the dominant feature in the situation, and it is assumed that, of the fixed 75 man-days, 50 are used in cultivation and 25 in harvesting; and further that, while it may not be impossible to reduce the manpower with regard to cultivation, no appreciable progress in this direction is likely in harvesting. This latter, then, must be considered a limiting factor, which cannot be altered. AGEE then discusses the possibility of increasing the basal production of 5 tons of sugar, as has been done at Waipio and Ewa, first to 10 tons and then to 15 tons per crop; and he approaches the problem from two separate points of view, firstly by increasing the yield of sugar on the estate and secondly by maintaining the yield on the estate, but securing it from a smaller area under cultivation. The following table will illustrate the result likely to be

obtained along these two lines of work:—Formula (1) gives the very moderate hypothetical yield which he has taken as a basis; (2) and (3) show the result of the first method of improvement, and (4) and (5) that obtained by the second.

	Basis of production. Tons per acre.	Acreage.	Tons Sugar.	Man-Days Used. Total.	Cultivation.	Harvesting.
(1)......	5	1,000	5,000	75,000	50,000	25,000
(2)......	10	1,000	10,000	75,000	25,000	50,000
(3)......	15	1,000	15,000	75,000	—	75,000
(4)......	10	750	7,500	75,000	37,500	37,500
(5)......	15	600	9,000	75,000	30,000	45,000

It is obvious from (2) and (3) that, in spite of any reduction in the amount of labour required per acre for cultivation, whether by altered methods or the introduction of labour-saving devices, unless the means are available of considerably increasing the labour force, the line of increasing the total output of sugar on the estate very quickly will lead to an absurdity. On the other hand, from (4) and (5), by decreasing the cost of producing a ton of sugar *in man-days*, there is some reason for hopefulness. But here a new limiting factor is introduced, namely, the ultimate productive power of the land. The first work before the planter who wishes to proceed along this line of improvement is to determine, by appropriate methods, the maximum productive capacity of the land on his estate, and especially of the different fields of which it is composed. Then only will he be in a position to work for increased production, by discarding those fields which are found to be most deficient, and will ascertain to a certain degree how far he is justified to proceed with the experiment. It may be presumed that there will be many uses found for the discarded fields, although such are not specifically referred to in the present report, such as the growth of food or fuel for the labour, or fodder for the cattle on the estate.

The Director looks forward to the time when the field operations will be planned, not only on the financial expenditure predicted for the crop, but also on the extent to which each field and each ton of sugar obtained from it shall draw upon the basic resources at command. Such estimates will lead to decisions as to how man-days, water, nitrogen, etc., can be combined to the greatest advantage. He considers that, under leeward, irrigated conditions, with a warm climate, the most profitable sugar production will be apt to be found in high yields per acre; while in the cooler, humid tracts, it will probably be based upon the yield per man-day. The discussion is concluded with a reference to two striking examples of agriculture intensified during recent years in the latter direction.

The field experiments conducted during the year on different estates number 121. Besides these a large series of "observation tests" have been made, although in the absence of details we confess to be unable to determine exactly what these may be. They are referred to as serving as a means of getting information quickly on various planting operations, deductions being made without waiting for final results at harvest. Such a description would fit in with the observations made by every agricultural officer during the whole of his service as a matter of course, for he is always learning, but probably they refer here to special points on which attention is being for the moment concentrated The character and results of the field experiments are not mentioned in the report, but certain preliminary observations by Verret are reproduced, and these appear to be specially germane to the subject with which we are dealing, namely, increased production. Verret draws special attention to what he considers to be the two most important points in field work as now conducted in the islands

which have influence on the ultimate yield of sugar. These are not altogether new, but their representation appears to us to be sufficiently striking to be interesting to our readers. The first point is with regard to manuring at the proper time and the second concerning the avoidance of delay in getting the cut cane, and especially the burnt cane, to the mill at the earliest possible moment.

During recent years increased quantities of manure have been given on most plantations and this has been followed by poorer juices. It is acknowledged that the increase in manure is not wholly responsible for this deterioration, but owing to labour difficulties there have been longer seasons, changes in the varieties grown and delay in getting burnt cane to the mills, besides which climatic conditions have been more unfavourable, and all of these have had their effect. None the less, it is assumed that, other things being equal, increasing the nitrogen supplies has a tendency to produce poorer juice. VERRET offers as a solution of this difficulty early manuring, the applying of a few large doses in place of more numerous smaller ones. At Waipio, during the past eight years, the nitrogen given has increased from 200 lbs. per acre to 310, and this without losing any of the juice purity. This result has been attained by giving early larger doses and carefully controlling the water supply towards harvest. In the two four-year periods the tons of cane required for the production of one of sugar have been decreased from 8·38 to 7·89, and the sugar obtained per acre per month has been doubled during the whole period, this result being mainly due to more careful manuring. It is further pointed out that the increased cost entailed by this heavier manuring is mainly in the greater cost of the manure itself, while the increase in the cost of labour has been small. "Taken as a whole, there is nothing by which labour can be employed on a plantation which offers such large returns as the applying of the fertiliser at the proper time."

As a result of 30 experiments on different plantations it was found that cane loses 3 per cent. per day of its sugar after burning, less for the first day but in increasing quantities, so that in five days the loss reaches 15 per cent. Another fact, hitherto largely overlooked, is that the cane also loses appreciably in weight. It has been determined that burnt cane if left standing loses $1\frac{1}{3}$ per cent. of its weight per day for the first five days, and when cut it loses about double of that amount. Thus, even were there no deterioration in the juice, the loss caused by delay in milling would work out at about 2 per cent. per day. Putting this into concrete figures, it is estimated that, in a mill grinding 1000 tons of cane a day with an average delay of three days between burning and milling, if the delay can be decreased by one day, it will mean a saving of juice equal to that flowing continuously from a one-inch pipe. Milling the cane one day sooner after burning than is at present the case would mean an increase in output on the island of 15,000 to 20,000 tons of sugar a year.

Next in interest to the question of increased production in the current Report is perhaps the section dealing with the pests and diseases, and we hope to be able to refer to this in a succeeding number of the Journal. The improvement of sugar cane through bud selection, the soil survey and investigation, and sugar cane forestry, referred to in our last year's review, all show progress, and these sections provide interesting reading.

C. A. B.

Sir ROBERT PARK LYLE, Bart., has resigned his position as Chairman of Tate & Lyle, Ltd., owing to ill-health, but will retain a seat on the Board. Sir ERNEST W. TATE, Bart. has been appointed President of the firm, while Mr. C. E. LEO LYLE has been appointed Chairman of the Board, and Mr. J. W. MACDONALD, Vice-Chairman.

The Java Sugar Crop of 1922.

By our Continental Correspondent.

During the 1922 season 183 sugar factories have been active in Java. They had planted 398,080 acres of cane and harvested the produce of all these between April and the beginning of December, save one factory which ended its grinding about a fortnight later. The total amount of sugar is not yet fully known, but the best estimates put it down at 1,773,327 long tons or 4·45 tons to the acre.

The figures relating to tonnage of cane and the yield of sugar per 100 cane are not yet available, neither are those of the results of the individual factories and of the residencies, but at any rate it is known that the agricultural and technical results are very good and greatly exceed the estimates made at the beginning of the crop. All the sugar produced has been sold to exporters and consumers a long time ahead of manufactuie, so that all the sugar turned out by the factories has been sent off immediately to the purchasers' godowns.

The sales effected by the Associated Java Sugar Producers, (which body disposes of about 90 per cent. of the total crop) have been as follows :—

	Piculs [1]	
White plantation sugar, first runnings..	14,180,200	
White plantation sugar, second runnings..	357,000	
Brown sugar of every description..	11,125,200	
Molasses sugar	345,200	
Sack sugar	26,000	
Total share of the Associated Java Sugar Producers..	26,033,600	piculs, or
	1,627,000	tons.

The average price of these sugars was 11·92 guilders[2] per picul for the whites, 10·68 for the brown sugars, basis 98° polarization : and 10·45 for the brown sugar, basis 96·5° polarization. It is understood that the sugar sold by parties outside the Association will have fetched similar prices.

The total crop may be assumed at 29 million piculs, of which 8 millions were still unshipped at the end of December. Up to that date, 19,016,757 piculs had been exported, while the territory of the Dutch East Indies is considered as consuming some 2,400,000 piculs per annum.

The destinations of that part of the crop exported by 31st December were as follows :—

	Piculs.		Piculs.
Europe	4,019,150	Japan	2,760,850
Turkey in Asia	74,011	Formosa	234,235
Egypt	156,449	British India	4,601,186
Suez f.o.	2,854	Australia	2,350
Port Said f.o.	1,350,276	Siam	210,098
Vancouver	115,294	Not yet specified	688,654
Singapore..	745,299		
China	781,092	Total exportation....	19,016,757
Hongkong	3,314,959		

Since large scales have been effected to British India for January and February delivery, the share of that country will become much larger before the balance of 8 million tons has been disposed of.

[1] 1 picul—136·2 lbs., or roughly $\frac{1}{16}$ of a ton. [2] 1 guilder—1s. 8d.

For next year a smaller crop is anticipated. The area under cane is only slightly larger than in 1922, viz.: 1·3 per cent. more; but the condition of the cane is not so good as in the previous season. Generally speaking, a crop of 28 million piculs is expected, of which about one half will consist of white sugar.

Some Further Notes on Milling Plant Performance Estimations.

By P. H. PARR.

The high-fibre canes appear to be of increasing importance: the cultivation of the Uba and similar canes, with 14-18 per cent. fibre, is extending in Africa; and the question of India, with the indigenous canes of 16-22 per cent. fibre, is becoming more prominent. The author has had, on so many occasions, roughly to estimate the extractions from these high-fibre canes, that he decided to work out the complete set—a very tedious business—for canes of 16, 18 and 20 per cent. fibre content, resulting in tables similar to Tables V and VI on pages 301-2 of this *Journal* for June, 1922. As these tables may, under present conditions, be of value to other cane sugar engineers concerned with the milling plants, the author has decided to publish them.

The accompanying tables are headed Table V (continued) and Table VI (continued), as they are precisely extensions of the previous tables, for the higher fibres. They have been carefully worked out on exactly the same bases as the tables of the earlier article, and so are strictly comparable with them. With these high-fibre canes it is perhaps easier to crush to a higher fibre content of the bagasse, but it seemed to be better, from many points of view, to retain the previous bases of calculation for the tables, the advantages of direct comparison outweighing any necessary corrections to suit special circumstances.

Approximate calculations of the effects of varying rates of imbibition can readily be made in the same manner as indicated on page 303 (*I.S.J.*, Juno, 1922), and to facilitate these calculations there is added the following table of the dry-crushing extractions:—

N.	16	18	20 per cent fibre.
3	64·7	59·3	53·6
5	67·6	62·7	57·4
6	71·4	67·1	62·5
8	73·4	69·6	65·5
9	76·8	73·2	69·5
11	78·6	75·2	71·9

It may here be mentioned that, for final bagasses with higher fibre contents than those adopted for the tables, it is usually sufficient for practical purposes merely to consider the bagasse as tabulated, and to calculate the effect of a further squeeze on such bagasse. For instance, take a cane of 16 per cent. fibre, crushed by an 11-roll mill to a final bagasse of 55 per cent. fibre, with simple imbibition: the table gives the bagasse as 34 per cent of the cane, and with a composition of 47 per cent. fibre, 5·8 per cent. sugar, and 47·2 per cent. moisture, or 53 per cent. dilute juice; if this bagasse is squeezed to 55 per cent. fibre, the total amount will be reduced to $16/0·55=29$ per cent. of the cane, so that dilute juice equal to $34 - 29 = 5$ per cent. of the cane will be expressed, which will contain sugar equal to $5 \times 5·8/53 = 0·55$ per cent. of the cane: since the cane contains $84 \times 0·18 = 15·12$ per cent. of sugar, this means an additional extraction of $0·55/0·1512 = 3·6$ per cent., giving a final extraction of $86·9 + 3·6 = 90·5$ per cent.

Some Further Notes on Milling Plant Performance Estimations.

It is interesting to note the difference between the results to be expected from a high-grade Peruvian cane of say 13 per cent. fibre, and juice purity 88, and those from a common Indian cane of 18 per cent. fibre and juice purity 75. Taking 11-roll mills and simple inbibition in each case, then for the Peruvian cane we may expect an extraction of 90·5 per cent., so that there will be extracted $87 \times 0·18 \times 0·905 = 14·17$ per cent. of solids, with a purity of 88: allowing 2 per cent. factory losses, 96° sugar, and 42° molasses, the commercial sugars will be 11·83 per cent. of the cane. For the Indian cane, the extraction will only be 84·2 per cent., or $82 \times 0·18 \times 0·842 = 12·44$ per cent. of solids, with a purity of 75: allowing 5 per cent. factory losses and 45° molasses, the 96° commercial sugar will amount to only 6·95 per cent. of the cane, or a return of less than 60 per cent. of that obtained in Peru. These figures, rough as they are, are in close accordance with the results at present actually being obtained in the two countries mentioned, and provide a further test that the methods of calculation adopted by the author really do give results agreeing very closely indeed with modern practical results.

Table V (continued).—Simple Imbibition.

				Mixed Juice.			Bagasse.					
No. of Rolls.	Imbibition per cent. cane.	Extraction per cent. sugar	N.J. per cent. cane.	Per cent. cane.	Gall./ton cane.	Brix.	Per cent. cane.	Per cent. fibre.	Per cent. sugar.	Per cent. water.	B.T.U./lb.	Lb evaporation per ton cane
						16 per cent. Fibre.						
3	0	64·7	54·3	54·3	113	18·0	45·7	35·0	11·7	53·3	1841	1667
5	0	67·6	56·8	56·8	119	18 0	43·2	37·0	11·3	51·7	1951	1670
6	8	76·9	64·6	68·0	142	17·1	40 0	40·0	8·7	51·3	1993	1581
8	8	79·0	66·3	69·9	146	17·1	38·1	42·0	8·3	49·7	2103	1588
9	16	85·3	71·6	80·5	169	16·0	35·5	45·0	6·3	48·7	2181	1535
11	16	86·9	73·0	82·0	173	16·0	34·0	47·0	5·8	47·2	2285	1540
12	24	89·8	75·4	90·0	190	15·1	34·0	47·0	4·5	48·5	2205	1486
14	24	90·3	75·8	90·0	190	15·2	34·0	47·0	4·3	48·7	2192	1477
15	32	92·3	77·5	98·0	208	14·2	34·0	47·0	3·4	49·6	2138	1441
17	32	92·6	77·8	98·0	208	14·3	34·0	47·0	3·3	49·7	2131	1436
18	40	94·0	78·9	106·0	225	13·4	34·0	47·0	2·7	50·3	2094	1411
20	40	94·2	79·1	106·0	225	13·4	34·0	47·0	2·6	50·4	2088	1407
						18 per cent. Fibre.						
3	0	59·3	48·6	48·6	101	18.0	51·4	35·0	11·7	53·3	1841	1875
5	0	62·7	51·4	51·4	107	18·0	48·6	37·0	11·3	51·7	1951	1879
6	8	72·9	59·8	63·0	132	17·1	45·0	40·0	8·9	51·1	2005	1788
8	8	75·2	61·7	65·1	136	17·1	42·9	42·0	8·5	49·5	2116	1799
9	16	82·4	67·5	76·0	160	16·0	40·0	45·0	6·5	48·5	2194	1740
11	16	84·2	69·0	77·7	164	16·0	38·3	47·0	6·1	46·9	2303	1748
12	24	87·3	71·6	85·7	181	15·0	38·3	47·0	4·9	48·1	2229	1690
14	24	87·9	72·0	85·7	181	15·1	38·3	47·0	4·7	48·3	2217	1683
15	32	90·2	74·0	93·7	199	14·2	38·3	47·0	3·8	49·2	2162	1642
17	32	90·7	74·4	93·7	199	14·3	38·3	47·0	3·6	49·4	2150	1632
18	40	92·3	75·7	101·7	216	13·4	38·3	47·0	3·0	50·0	2113	1604
20	40	92·6	75·9	101·7	216	12·4	38·3	47·0	2·9	50·1	2106	1599

No. of Rolls.	Imbibition per cent. cane.	Extraction per cent. sugar	N.J. per cent. cane.	Mixed Juice. Per cent. cane.	Gall./ton cane.	Brix.	Bagasse. Per cent. cane.	Per cent. fibre.	Per cent. sugar.	Per cent. water.	B.T.U./lb.	Lb. evaporation per ton cane.
					20 per cent. Fibre.							
3	0	53·6	42·9	42·9	90	18·0	57·1	35·0	11·7	53·3	1841	2083
5	0	57·4	45·9	45·9	96	18·0	54·1	37·0	11·3	51·7	1951	2091
6	8	68·6	54·9	58·0	122	17·0	50·0	40·0	9·0	51·0	2011	1993
8	8	71·3	57·0	60·4	127	17·0	47·6	42·0	8·7	49·3	2128	2007
9	16	79·1	63·3	71·6	151	15·9	44·4	45·0	6·8	48·2	2202	1937
11	16	81·3	65·0	73·5	155	15·9	42·5	47·0	6·3	46·7	2315	1950
12	24	84·8	67·8	81·5	172	15·0	42·5	47·0	5·2	47 8	2248	1893
14	24	85·5	68·4	81·5	172	15·1	42·5	47·0	4·9	48·1	2229	1878
15	32	88·0	70·4	89·5	190	14·2	42·5	47·0	4·1	48·9	2180	1837
17	32	88·6	70 9	89·5	190	14·3	42·5	47·0	3·9	49·1	2168	1827
18	40	90·4	72·3	97·5	207	13·3	42·5	47·0	3·3	49·7	2131	1795
20	40	90·8	72·6	97·5	207	13·4	42·5	47·0	3·1	49·9	2119	1784

Table VI (continued)—COMPOUND IMBIBITION.

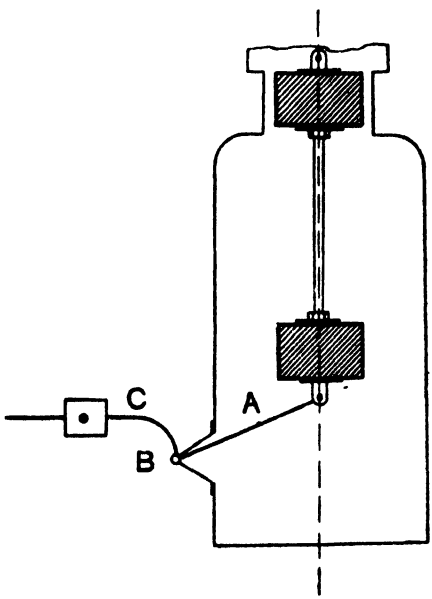
					16 per cent. Fibre.							
9	16	87·9	73·8	80·5	169	16·5	35·5	45·0	5·1	49·9	2108	1483
11	16	90·3	75·9	82·0	172	16·7	34·0	47·0	4·3	48·7	2192	1477
12	24	93·9	78·9	90·0	189	15·8	34·0	47·0	2·7	50·3	2094	1411
14	24	94·1	79·0	90·0	189	15·8	34·0	47·0	2·6	50·4	2088	1407
15	32	96·6	81·1	98·0	206	14·9	34·0	47·0	1·5	51·5	2021	1362
17	32	96·7	81·2	98·0	206	14·9	34·0	47·0	1·5	51·5	2021	1362
18	40	97·6	82·0	106·0	224	13·9	34·0	47·0	1·1	51·9	1996	1345
20	40	97·7	82·1	106·0	224	13·9	34·0	47·0	1·0	52·0	1990	1342
					18 per cent. Fibre.							
9	16	85·0	69·7	76·0	159	16·5	40·0	45·0	5·5	49·5	2133	1691
11	16	86·7	71·1	77·7	163	16·5	38·3	47·0	5·1	47·9	2242	1702
12	24	92·0	75·5	85·7	180	15·9	38·3	47·0	3·1	49·9	2119	1608
14	24	92·5	75·9	85·7	180	15·9	38·3	47·0	2·9	50·1	2106	1599
15	32	95·5	78·3	93·7	198	15·0	38·3	47·0	1·7	51·3	2033	1543
17	32	95·6	78·4	93·7	198	15·0	38·3	47·0	1·7	51·3	2033	1543
18	40	97·0	79·5	101·7	215	14·1	38·3	47·0	1·2	51·8	2002	1519
20	40	97·1	79·6	101·7	215	14·1	38·3	47·0	1·1	51·9	1996	1516
					20 per cent. Fibre.							
9	16	82·2	65·8	71·6	150	16·5	44·4	45·0	5·8	49·2	2151	1892
11	16	84·1	67·3	73·5	154	16·5	42·5	47·0	5·4	47·6	2261	1904
12	24	90·1	72·1	81·5	171	15·9	42·5	47·0	3·4	49·6	2138	1801
14	24	90·5	72·4	81·5	171	15·9	42·5	47·0	3·2	49·8	2125	1789
15	32	94·2	75·4	89·5	189	15·2	42·5	47·0	2·0	51·0	2051	1728
17	32	94·5	75·6	89·5	189	15·2	42·5	47·0	1·9	51·1	2045	1722
18	40	96·3	77·0	97·5	206	14·2	42·5	47·0	1·3	51·7	2008	1691
20	40	96·4	77·1	97·5	206	14·2	42·5	47·0	1·2	51·8	2002	1686

An Improved Michaelis Steam Trap.[1]

By C. C. W. van GANSWIJK.

For the removal of the condensed water from the steam drums of evaporators, automatic Michaelis steam traps are frequently used, these having the advantage (when provided with a gauge-glass) of also serving as a measuring apparatus. Their action depends on a float which with the rising or falling of the water present in the vessel moves along a vertical rod.

In the lowest position, i.e., when the apparatus is empty, the mechanism of the valve is operated by the weight of the float itself, and when at the highest level of the water by the upward pressure of the weight of water displaced by the float, which depends on the volume of the float. Hence the ratio of the weight of the float to its volume should not be too great. It is generally made in the form of an air-tight cylinder of sheet-iron, weighing about 6 kg., and displacing about 12 litres, which when immersed exerts an upward pressure of about 6 kg., which force is quite sufficient to operate the valve mechanism.



It frequently happens, however, probably from the recurring differences of temperature and pressure in the steam trap, that pin-holes occur in the float, which causes of leakage gradually increase. Then the upward pressure is no longer sufficient to move the valve, and the contrivance refuses to work. Although, when in new condition, the Michaelis apparatus operates very satisfactorily, with many users it has fallen into discredit owing to this defect of the hollow float.

In consequence, the author has invented a construction which is wholly independent of the weight of the float, so that a solid one may be used, the disadvantage named being thus entirely avoided.

In this modification the lower end of the vertical rod mentioned above is fixed to the lever *A* (shown in the sketch) having the fulcrum *B*, to which a second lever *C* provided with a movable weight is fixed. Now at the top and at the bottom of the vertical rod two solid wooden floats, each having a volume of about 6 litres, are attached. By means of the movable weight, equilibrium is effected when the lowest float is submerged, and this may be done practically in a couple of minutes by adjusting the weight so that the apparatus operates well.

And the explanation is simple : When water level is between the floats, the upward pressure is nil; but when the top float has been submerged by the rising water, an upward pressure of about 6 kg. is exerted, and, conversely, when the water level falls below the lower float its weight will exert a downward force of about 6 kg.

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[1] *Archief*, 1922, No. 44.

The actual weight of the two floats does not come into consideration, and if need be they may be made of thick sheet lead, but then a sufficiently heavy movable weight for effecting equilibrium must be provided. However, in order to make the whole apparatus as light as possible, they may be made of some suitable wood, and naturally by making their volume larger than above stated, the force exerted may be increased above 6 kg. This modification has been fitted to two existing Michaelis steam traps; and both are now working excellently.

Report on Improvements in Sugar Machinery.

By S. S. PECK.

A Committee, consisting of Messrs. S. S. PECK (Chairman), W. A. RAMSAY, HORACE JOHNSON, J. N. S. WILLIAMS, W. G. HALL, E. KOPKE, and JAS. WEBSTER, have drawn up a Report on the progress made in the design of sugar machinery for the Hawaiian Sugar Planters' Association, which report covers the year ending September 30th, 1922. A summary here follows:—

THOMAS & PETREE PROCESS.

In this process, a report upon which has been issued,[1] three new forms of apparatus are used, viz., the Dorr clarifier, the Petree automatic limer, and the "Dorrco" pump.

Dorr clarifier.—This is a form of continuous settler, which was described in the 1920 Report to the H. S. P. A.[2] A number of this apparatus have now been installed in various Cuban factories, and are giving satisfaction, their great advantage over the ordinary intermittent type being that the juice is always being drawn off at the point of its maximum clarity, while the mud is being continuously removed at the points of its greatest density. In the usual intermittent settling tank, it is difficult to draw a sharp line between the juice which should go to the evaporators, and that which should be passed to the filter-presses; but it is generally considered that with this system there is a better opportunity to regulate the lime necessary for the optimum clarifying effect. But while it is true that errors in liming are quickly realized, the observation generally comes too late. Adjustment may be made on succeeding juices, but with the quality of the cane frequently changing, this adjustment is itself often in error.

On the other hand, with the larger volumes subsiding in continuous settlers, there is a greater assurance of clean juice going to the evaporators, though there is still the question of maximum rise in purity as the result of the two systems to be determined. The results of a cleaner clarified juice have been demonstrated at the Mercedita factory in Cuba, where the insoluble matter in the raw sugar was reduced by over 50 per cent. following the substitution of ordinary defecators by Dorr clarifiers. A further advantage in this type is economy of floor-space used, increase in capacity not being obtained by putting in more settlers, but by adding more compartments to the same area. The difference is then only in the greater height of the apparatus.

Petree automatic limer.—This machine will add lime continuously to the juices from the first and second mills separately; and consists of a receiving tank for the milk-of-lime, supplied from the slaking tank, bucket elevators for lifting this lime milk to a distributing plate or apron being provided. The elevators are driven from the mills in such a way that when the mills stop, the elevators likewise are arrested.

[1] *I.S.J.*, 1923, 26. [2] *I.S.J.*, 1921, 93.

On the plate are arranged two plates or baffles, so that the stream is divided into three equal parts, a third going to each juice and a third going back to the holding tank. These baffles can be adjusted so as to increase or decrease the amount going to the juices, the excess being always returned. There are no valves to get out of order or pipes to become clogged up; and the milk-of-lime is kept agitated by a stirrer as well as by buckets.

"*Dorrco*" *pump*.—This is a form of diaphragm pump which is used to remove the mud from the subsiders. Its body is divided into an upper and lower chamber by means of a diaphragm. This is clamped rigidly around its periphery to the pump body by means of a retaining ring, which can be readily removed when it is necessary to renew. A lift yoke containing the discharge valve is attached around the central opening in the diaphragm. The lower or suction chamber contains the suction valve operating immediately over the feed or suction line to the pump; while the upper or discharge chamber is open, and is provided with a discharge lip, which is from 4 to 6 in. above the discharge valve. This depth of discharged mud protects the valve from air in case it is prevented from seating properly by foreign matter. Both valves are opened by the action of the diaphragm, and are closed by gravity, no springs being required. They are retained in place by suitable guide webs; and, further, both valves may readily be removed and cleaned. The rate of discharge is first fixed by the length of the stroke and then delicately regulated by admitting a small quantity of air through a needle valve into the suction chamber.

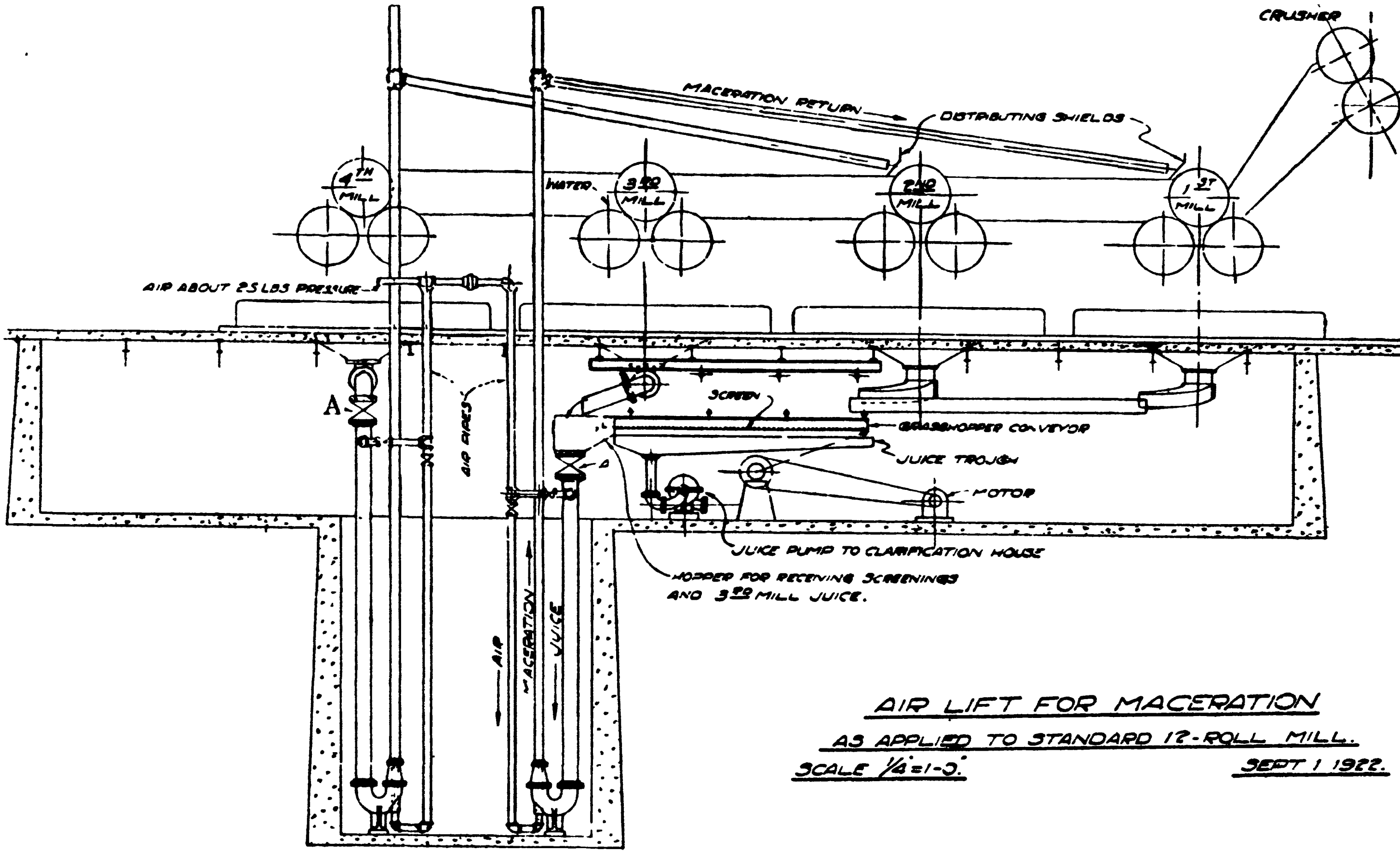
AIR-LIFTS FOR MACERATION WATER.

From time to time, attempts have been made or suggestions offered as to means to eliminate the juice strainer and cush-cush elevator; but a serious stumbling block has always been the difficulty of elevating this unstrained juice by means of any known pumping device. Devices have been invented by means of which it was hoped to attain this object, but the fact that none is working seems to indicate that the suggested arrangement does not work successfully. The following description and accompanying sketch is a contribution from the Honolulu Iron Works, and presents an interesting possible solution of this particular problem:—

The most objectionable feature about a milling plant is the juice strainer and cush-cush elevator. Juice is held absorbed by fine bagasse in inaccessible places, where it sours and contaminates the fresh juice coming from the mills; but the following lay-out aims to improve the method of handling the mill juices and prevent souring to a large extent if not entirely. The lifting of the maceration juice with all the particles of bagasse up to the blanket of bagasse on the intermediate carriers has not so far been accomplished by pumping, and now an air-lift is proposed, which apparatus is in use to-day in different industries for handling many liquids containing sediments resembling coarse particles of bagasse.

The accompanying drawing illustrates such a scheme as proposed for a 12-roller mill and crusher. The mixed juice from the crusher, first and second mills is run into a screen and strained, the juice going to the clarification house in the usual way. The screenings together with the unscreened juice from the third mill is raised by the air-lift to a sufficient height to allow it to flow to the usual place of maceration in front of the second mill. This screen is operated on the principle of the grasshopper conveyor, discharging the residues collected into the intake of the air-lift for the third mill.

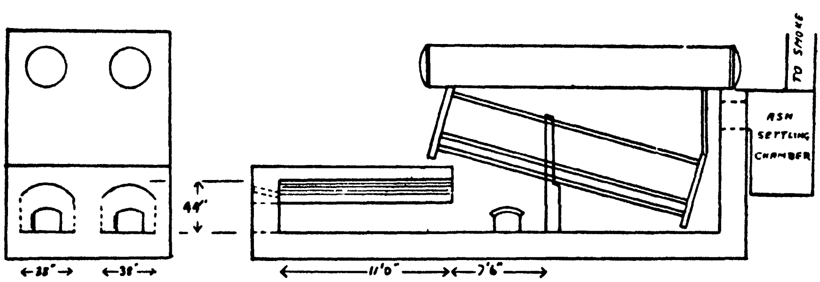
The juice with cush-cush from the fourth mill is similarly raised and returned in front of the fourth mill. A disadvantage of this system is the depth to which it is necessary to go down in order to obtain sufficient difference in weight


CRUSHER
MACERATION RETURN
DISTRIBUTING SHIELDS
4TH MILL
WATER
3RD MILL
2ND MILL
1ST MILL
AIR ABOUT 25 LBS PRESSURE
A
AIR PIPES
SCREEN
GRASSHOPPER CONVEYOR
JUICE TROUGH
MOTOR
JUICE PUMP TO CLARIFICATION HOUSE
HOPPER FOR RECEIVING SCREENINGS
AND 3RD MILL JUICE.
AIR
MACERATION
JUICE
AIR LIFT FOR MACERATION
AS APPLIED TO STANDARD 12-ROLL MILL.
SCALE 1/4"=1-0"
SEPT 1 1922.

between the contents of the down pipe and uptake in order to raise the mixture to a sufficient height. The distance from the intake to the bottom of the *U*-bend should be about 60 per cent. of the total length of the uptake; this means a depth of about 20 ft., the pipes being 4 to 6 in. diam., and the air pipe 1½ to 2 in. in diam. For a mill grinding 1000 tons of cane per day, it is assumed that 250 tons of juice or 50 gallons per min. are to be raised. This would require about 20 cub. ft. of free air per min. compressed to about 25 lbs. per sq. in., or 1·75 h p. While the overall efficiency of the air-lift is only from 25 to 30 per cent., one must remember that the efficiency of a motor-driven centrifugal pump of this capacity is about 50 per cent. The difference when applied to 1·75 h.p. is small. Valve *A* is shown at the top of the intake pipe, which can be closed when the mill is shut down to allow a run of wash water to be blown through, thus getting rid of all chance of inversion by stagnation.

MOLASSES AS BOILER FUEL.

Mr. E. W. GREENE, acting manager of the Oahu Sugar Co., has contributed the following on this subject: We have re-conditioned two old boilers for burning molasses. One of the boilers is a Babcock & Wilcox water-tube, rated at approximately 200 boiler horse-power. The furnace built for this is of the extension type divided so that each section is 11 ft. long, 38 in. wide, and 44 in. high, as shown in the accompanying rough sketch. We believe that in order to obtain good results



FURNACE FOR MOLASSES BURNING OAHU SUGAR COMPANY

in burning molasses to produce steam, the furnace should be long and relatively narrow in order to secure the effect of the heated brickwork in maintaining good combustion. The burners which we now use are the result of considerable investigation and development by our mill staff, and have operated successfully for several months. Steam is used as the atomizing medium and the flame is similar in appearance to an oil fire. No auxiliary fuel is required to maintain the furnace temperature. The molasses is pre-heated to about 180°F. (82°C.), and is pumped to the burner at a pressure of about 60 lbs. When operating under these conditions there is a loss of available potash-containing ash, but the boiler operates at approximately its normal rating, while the ash recovery is about 4·5 per cent. by weight of the molasses burned. A small part is recovered as black furnace ash, which contains about 30 per cent of water-soluble potash. But the greater part of the ash is in the form of a white dust which collects on the tubes, baffles, and in a trap in the uptake, which dust analyses considerably higher in potash. It is necessary to clear the boilers twice a shift by blowing the dust from the tubes and baffles with a steam lance, and removing it through cleaning doors provided in the setting and at the uptake. A 7 × 20 H.R.T. boiler has also been arranged for burning molasses with a suitable design of furnace.

The Sugar Industry in Mauritius.

Department of Agriculture Report for 1921.[1]

The Report of the Department of Agriculture of Mauritius for the year 1921, as prepared by Dr. TEMPANY, comes to hand later than usual this year, the last report having been reproduced by us in October, 1921. We give below, slightly abridged, that portion relating to the sugar industry.

The 1921-22 Crop.—The final estimate of the 1921–22 crop is given as 206,150 metric tons, as compared with 259,870 tons in 1920, 235,190 tons in 1919, 252,770 tons in 1918, and 277,360 tons in 1914.

Yield of Vesou Sugar.—Of these estimated 206,150 tons, it was anticipated that 95·8 per cent. would consist of *vesou* sugar; the rest would be 0·3 per cent. of first syrups, and 3·9 per cent. of low syrups. The high proportion of *vesou* sugar (i.e., first grade plantation whites) continues to be a feature of the sugar manufacture of the colony.

Factory work of 1921.—The average extraction of sugar for the crop was estimated to be 10·2 per cent. of the weight of cane handled, being the lowest recorded since 1909. This was due to very unfavourable weather conditions which prevailed during the greater part of the grinding season. The highest yield of recent years was 10·95 in 1918, while that of 1920 proved to be 10·76. During 1921 there were 54 factories in operation, the number having remained unchanged since 1918. Very considerable improvements have been introduced into them during the year under review. The value of the machinery imported during 1920 approximated to 2½ million rupees, whereas in 1921 it came to over 5½ millions.

Among other items, the following new machinery was installed in 1920:—1 mill, 7 economizers, 6 derricks, 8 crushers, 30 Messchaert cylinders, 15 defecators, 10 decanters, 6 quadruple effects, 30 crystallizers, 30 Weston centrifugals, 8 cane carriers, 6 sulphitation apparatus, 6 filter-presses, 5 juice heaters, 6 vacuum pans, 1 barometric condenser and 3 boilers.

During the year 1921, local firms have installed, among other items, the following machinery:—6 cane carriers, 2 mills, 3 sulphitation apparatus, 6 defecators, 2 filter-presses, 3 air-compressors, 4 quadruple effects, 6 vacuum pans, 2 air-pumps, 7 juice and magma pumps, 5 pans, 51 crystallizers, 7 boilers, 3 hydraulic attachments for mills, etc., etc.

The value of imported material for mechanical transport on sugar estates was about 1½ million rupees in 1920 and about 1 million in 1921.

Labour conditions.—Sugar manufacturing operations were again conducted under considerable difficulties during the year, owing mainly to labour shortage. Great difficulties were experienced in the reaping of the crop and also in the performance of cultural operations. As the result of the unprecedented prices paid for canes last year, a large number of small planters who, as a rule, worked as day labourers, found themselves in a position to dictate their terms to employers. These men, being no longer under the pressure of necessity, hired themselves out with considerable reluctance and at very high prices, thereby causing a dearth of hands and a greatly enhanced rate of wages.

The following table gives an idea of wages currently paid to day labourers and the cost of agricultural operations during the year:—

[1] For the two previous Reports, see *I.S.J.* 1921, 81 and 567.

	Rs.	Rs.	
Day labourers	2·00—	3·00	
Female labourers	1·00—	1·50	
Clearing land	150·00—	400·00	per arpent.
"Fosseyage"	50·00—	100·00	,,
Manuring	10·00—	20·00	,,
Weeding	50·00—	80·00	,,
Cutting canes	25·00—	50·00	,,

The result is seen everywhere in a marked lowering of the standard of cultivation adopted.

Mechanical cultivation.—In consequence of this state of affairs, considerably increased attention has been devoted to the adoption of labour-saving devices in relation to cultivation. During the year, eight tractors of five different makes were imported into the Colony, while public demonstrations of the work of two tractors were given by estate owners or importers, viz.: the Cletrac, and the Somua. The Cletrac cultivator has shown itself, so far, to be well adapted to certain classes of agricultural operations and a number have already been imported for use. The question has been further dealt with by a Joint Committee of the Board of Agriculture and of the Chamber of Agriculture under the Chairmanship of the Director of Agriculture. Under the auspices of the Committee, detailed information respecting the agricultural operations required to be performed in cane cultivation was collected and forwarded to the tractor experts of the English Ministry of Agriculture. A full report was subsequently received from the Ministry, in which were given details of tractors likely to prove useful in Mauritius, together with a list of ploughs and implements which appeared suitable. Of the tractors recommended, two have already been imported through private agencies, and the Government and the Chamber of Agriculture, acting in co-operation, subsequently made arrangements to import examples of the other tractors recommended by the Ministry, which had not already been introduced. Concurrently, a scheme for public tractor trials was devised, whereby opportunities will be given to all tractors existing in the Island to demonstrate their capacity. It is anticipated that these trials will take place in April, 1922. Concurrently, a considerable increase has taken place in the use of ploughs and cultivators for implemental tillage and, altogether, ploughs and accessories to the value of Rs. 83,433 have been introduced during the year.

In relation to cultivators, the difficulty has always been experienced of obtaining a sufficiently strongly built machine to withstand the wear and tear incident on work on the very stony soils characteristic of many localities of this country. Up to the present, probably the most successful cultivator has been one of simple design, manufactured in the Colony and locally known as the Daniel Cultivator.

With the very considerable field for the introduction of implements which undoubtedly exists in the Colony, there should be openings for manufacturers who can produce a type of cultivator suited to these conditions.

Area under cultivation.—At the end of 1920, the total area under sugar cane was estimated to be 171,845 arpents (179,240 acres), or 39·1 per cent. of the total area of the Colony; this is the highest on record. The increase in 1921 is small as compared with the increase in 1920, and it is estimated that the total area at the end of 1921 was about 172,000 arpents.

Indian cultivation.—At the end of 1920, the area cultivated by Indians was estimated to be 77,250 arpents (80,200 acres), or nearly 45 per cent. of the total

cane cultivation. In 1921, an appreciable increase took place, but exact figures are not yet available. It has always been a difficult matter to estimate exactly the area cultivated by Indian proprietors owing to the multiplicity of small plots which are scattered practically all over the Island and the fact that no system of land registration is in force. With the co-operation of the Census Commissioner, the attempt was made during the population census of 1921 to carry out an agricultural enumeration of the area cultivated.

The large profits made by Indians on last year's sales of canes have been, to a considerable degree, invested in the purchase of new lands. Such purchases have, however, been made in many cases at excessively large values, in anticipation of another year of very high prices for sugar, and it is to be feared that in some cases unfortunate results may ensue with the return of prices to a more normal level.

Irrigation of sugar cane.—The La Ferme Irrigation Scheme for the district of Black River is practically completed and the total area planted in canes dependent on the reservoir exceeds 3000 arpents, showing an increase of about 400 arpents over last year. Owing to the intense drought which prevailed during the year, the distribution of water to planters was stopped early in August and was only resumed in October.

The proposal for the establishment of an Experiment Station for the investigation of problems connected with the irrigation of sugar cane took definite shape during the year. This question has been under consideration for some considerable time. The necessity for its establishment had been shown by investigations into the rates of applications of water and the corresponding return of canes obtained in irrigated tracts. It appears that, in individual cases, more than 100 per cent. variation occurred between the amount of water applied by different planters per acre, and that no sort of correlation could be established between the amount of water used and the corresponding cane returns. There appeared reason to believe that, in many cases, excessive amounts of water were being applied and the gross return of cane from the irrigated area as compared with the total expenditure of water fell considerably short of what was to be expected from a comparison with the results obtained in other countries. In some cases, also, the methods employed for applying water involved a waste owing to the unduly long traverses which water was required to make before reaching the plants to be irrigated. Conseqently, the establishment of an experiment station was advocated with a view to investigating the most economical methods of applying water and the optimum frequency and depth of watering. Conjoined with this were questions in relation to cultivation, manuring and choice of cane varieties under irrigated conditions.

In February, 1921, the Council of Government, on the basis of a report by a Committee of the Board of Agriculture, sanctioned the appropriation of Rs. 30,000 for the creation of such an experimental Station and an arrangement was entered into with the Medine Sugar Estate Company Limited, whereby about 30 arpents of land were handed over to Government, free of rent, for a period of five years, for the purpose of establishing it. The work of laying out the Station was commenced in April, and at the end of the year was practically completed, the first canes being planted in the month of December. It is hoped that the work of this Station will throw light on many problems which are as yet obscure and will tend to increase the efficiency of irrigation practised in the Colony.

During the year, substantial progress was made with the irrigation scheme for the north of the Island, locally known as "La Nicolière" Scheme. This project is of considerably greater magnitude than the "La Ferme" installation,

and aims eventually at supplying water to some 10,000 arpents of cultivated land in the northern and north-western districts. The complete scheme comprises three storage reservoirs:—one at La Nicolière, one in the vicinity of Midlands and one at Calebasses, with appropriate feeders and distributories. During 1921, the construction of the reservoirs at La Nicolière was pushed on. The scheme is financed by means of a series of public loans. A first loan of Rs. 500,000 was raised under Ordinances No. 8 of 1919 and No. 6 of 1920 and a further loan of Rs. 500,000 was authorised by Ordinance No. 24 of 1921.

Disposal of the sugar crop.—The Sugar Planters' Syndicate, constituted under Ordinance No. 10 of 1919, was reconstituted this year under Ordinance No. 7 of 1921, practically all planters adhering thereto. The mean price per 50 kilos of last year's sugar output, sold to the Royal Commission, is not yet available, but approximates to Rs. 50·50; the gross value of the 1920 crop is estimated to have been approximately Rs. 250,000,000. The Royal Commission having ceased operations, the Syndicate is disposing of the local sugars to private buyers. At the present, the market has been uncertain and sales have ranged between Rs. 11 and Rs. 12 per 50 kilos on the average.

Cost of production.—The cost of production of sugar rose steadily since 1914 and reached its highest value in 1921. While last year immense profits were made on the sales of sugar, this year the return to nearly normal prices, associated with a maximum cost of production, will cause a large proportion of the usines of this Colony to close the sugar campaign with a deficit.

In relation to the sugar crop of 1920, records would be incomplete if allusion was not made to the special tax levied on the crop of that year for the purpose of constituting a special fund to be devoted to public development and improvement in the Colony, which was authorized under Ordinance No. 36 of 1920, whereby a special export tax of Rs. 40 per ton was levied on all sugars leaving the Colony during the period. This tax has yielded at the present time a total of Rs. 14,074,220. It is the intention to devote this fund to the carrying out of various developments and improvements, notably works of a sanitary character, while an expenditure of Rs. 100,000 for the erection of an Agricultural College and Rs. 100,000 for a Model Dairy have also been sanctioned. Expenditure from the fund is controlled by Government with the advice and assistance of an Advisory Board appointed under the terms of the above ordinance.

Pests and diseases of the sugar cane during 1921.—In relation to the *Phytalus smithi* campaign, operations for the control of the pest were greatly extended through the action of planters, whereby a special export tax of Rs. 0·20 per ton of exported sugar was levied for the purpose of providing funds therefor. For the year 1920 the yield of the tax was estimated to be Rs. 49,000, and this sum was accordingly placed on the estimates for expenditure in this connexion. In consequence, the plan of campaign was considerably extended, the principal feature consisting in the augmentation of the number of special patrol gangs to a total of 40.

Patrol gangs were divided into two classes:—(*a*) Peripheral patrol gangs which were specially designed to counteract the tendency of the pest to spread outwards, and (*b*) patrol gangs for operation at lightly infected centres within the infected area. Combined with this, the system of purchase of beetles collected by the public, which had been inaugurated since the commencement of the campaign, was maintained. The campaign was commenced in 1911-12 when over 26 million beetles were captured. The year 1916-17 saw over 78 millions

accounted for. Since then there has been a decline in numbers, 1920-21 producing about 23 millions. This reduction points to a further considerable diminution in the incidence of the pest. The point is clearly shown when detailed returns from different properties are examined. At the present time, numerous estates which were formerly heavily infected are now practically free from this insect, and the majority of the insects captured are derived from the newer centres of infection. The success which has attended so far these methods of repression must be regarded as most satisfactory.

The beneficial effects of the parasitic wasp *Tiphia parallela* imported in 1915 as an enemy of *Phytalus smithi* was again markedly in evidence in the Pamplemousses area. The insect has also been introduced and has become established at Joli Bois.

An important observation was recorded by the Assistant Director of Agriculture who established that the parasitic wasp, *Elis thoracica*, introduced by him in Mauritius in 1917 from Madagascar was exercising an extensive control on *Phytalus smithi* in the Pamplemousses area. Nothing is known concerning the natural host of the insect in Madagascar and it was introduced to Mauritius in the hope that the insect would adapt itself as one of the parasites of the melolonthid larvæ here existing; the evidence of its parasitism on *Phytalus smithi* is an interesting demonstration of its adaptability and is of considerable importance.

No other insect and fungoid pests of the cane have been markedly in evidence. The "Gros Moutouc" *Oryctes tarandus* has been considerably reduced in intensity on certain properties in Savanne as the result of methods of repression adopted which have included the digging out of larvæ and the capture of adult beetles. The parasitic enemy of the insect, *Scolia oryctophaga*, has not been observed during the year.

In relation to fungoid diseases of the sugar cane, root disease was in evidence at one of the properties in the Pamplemousses area; the attack responded to methods of treatment recommended by the Department of Agriculture.

Other bacterial and fungoid diseases have only been occasionally in evidence. The Mosaic disease of sugar cane which has attracted a great deal of attention in many other cane-growing countries has, so far, not been found to exist in Mauritius.

Experimental Investigation in relation to the Sugar Industry in Mauritius.—Experimental investigations have been continued during the year by the Department of Agriculture. In the field, these have comprised trials with manurial applications to cane and with varieties of canes. The results of manurial experiments arrived at in former years have been further substantiated, and it appears fairly clearly that under cultural conditions in Mauritius, the first requisite for successful cultivation is that the field should be supplied with organic manure in the shape of *fumier* (pen manure). Applications of molasses also give rise to considerable increases in the yields. The application of artificial manures, in addition to *fumier*, to virgin canes also occasions further increases in yield in the higher and wetter districts. On the lower lands, such applications to virgin canes are more problematical in their effects; to ratoon canes, they are more beneficial. The most advantageous artificial manure to employ is nitrogen in a quickly acting form, conveying about 60 lbs. of nitrogen to the acre; sulphate of ammonia and nitrate of soda both give satisfactory results but sulphate of ammonia seems rather better suited to Mauritius conditions than nitrate of soda. Potash sometimes leads to profitable increases in yield but its effect is more

variable than that of nitrogen while phosphatic manures show still greater variability in their effects. The latter result is unexpected inasmuch as the soils of Mauritius are characteristically deficient in phosphoric acid. During the year, an extensive series of experiments was carried out with nitrate of ammonia, a new synthetic nitrogenous manure produced from atmospheric nitrogen. The experiments, conducted on virgin canes at different points, indicated that this manure gave results fully equal if not superior to those obtained with sulphate of ammonia.

In relation to the trials with varieties, as the result of the extensive experiments carried out by the Department of Agriculture at its own Experiment Station and at co-operative experiment stations on estates, a number of new varieties have been selected as more than ordinarily promising and are specially recommended to planters for trial. Planting material of these new varieties was placed at the disposal of planters during the year.

In relation to laboratory investigations, an extensive research was carried out and the results published relative to the composition and utilization of exhausted molasses, with special reference to the manufacture of industrial alcohol.

The question of the deterioration of Mauritius sugar during storage was also made the subject of investigation and the results thereof have been thrown together in the form of a Bulletin for publication.[1]

Other experimental work in progress has included investigation into the effect on the biological processes of the soil of application of molasses, a point which is of considerable importance in view of the proved value of dressings of molasses to cane plantations. Investigations have also been commenced with a view to erecting standards of fertility for different types of Mauritius soils, with special reference to recent developments in relation to biological functions and soil acidity, and as preliminary to the resumption of work on the general soil survey of the Colony, which, owing to a variety of causes, had been temporarily suspended.

Ten Hawaiian Sugar Crops, 1913-1922.[2]

Year.	*Hawaii.* Short Tons.	*Maui.* Short Tons.	*Oahu.* Short Tons.	*Kauai.* Short Tons.	*Totals.* Short Tons.
1913	197,415	124,819	124,228	100,336	546,798
1914	217,654	144,940	133,560	120,884	617,038
1915	240,785	160,283	129,997	115,380	646,445
1916	197,654	150,312	136,966	108,551	593,483
1917	232,132	147,648	145,550	119,244	644,574
1918	163,192	137,786	162,152	113,712	576,842
1919	207,731	132,991	152,863	109,998	603,583
1920	185,729	136,170	129,572	105,400	556,871
1921	197,064	115,599	125,462	101,071	539,196
1922	228,954	123,847	153,777	102,499	609,077

The 1922 export surplus of sugar of the South African Union, amounted to about 33,500 tons and was all shipped to the United Kingdom. The 1922 crop in Natal attained to 157,521 long tons, while the 1923 one is provisionally fixed at 200,000 tons.

[1] *I.S.J.*, 1922, 463, 527.

[2] Compiled by the Bureau of Labour and Statistics, Hawaiian Sugar Planters Association.

Recent Work in Cane Agriculture.

DE HUIDIGE STAND DER MECHANISCHE GRONDBEWERKING OP JAVA (THE PRESENT POSITION REGARDING MECHANICAL TILLAGE IN JAVA SUGAR CANE CULTIVATION). *C. E. van der Zyl. Mededeelingen van het Proefstation voor de Suikerindustrie. 1922, No. 4.*

The author gives a summary of the many attempts to introduce mechanical tillage in place of manual labour in the Java cane fields. The conditions are somewhat peculiar, in that the soil must be worked during or immediately after the preceding paddy crop reaping, and therefore in a thoroughly wet state. Any system which delays the drying out and aëration of the soil in the quickest possible manner is doomed to failure, and, excepting in the case of light soils, all forms of ploughing have thus proved to be unsatisfactory. After ploughing, the heavy soil must be left for at least a week before it can be harrowed. As regards ploughing, then, although technically possible time and money are lost; it has no advantage over trenching; ploughed lands have been found to require more water, and the canes tend to lodge a good deal in them.

The existing method of cultivation, generally known by the name of the Reynoso system, consists in digging deep trenches and heaping the wet soil on the banks between them. The soil in the trenches dries quickly and becomes rapidly fitted for the planting of the canes, while that thrown on the banks dries and crumbles more slowly, but is in good condition when the various earthings up of the growing canes are called for. The question thus arises as to whether mechanical trenching is possible. There are two main methods of supplying the power, the cable system and tractors. As regards the latter, it has unfortunately been found that, even with the caterpillar type, they cannot be run over the soil without slipping, and there appears to be little hope entertained of this difficulty being overcome. This throws us back on the cable system, which was the first method introduced for trial on the cane lands. Cable-drawn trenching implements thus appear to be the best that can, in the existing state of knowledge, be used in approaching the problem to be solved. The results of various experiments have been more or less satisfactory and these are detailed at some length: lighter cable trucks have been suggested and it has also been thought that dividing the trenching into two operations may be more feasible. The main paper is divided up into the following sections: the relation between the period of planting and mechanical tillage, ploughing versus trenching, the cable system and the earlier trials with the Heuck trench plough of the Netherlands Trading Co., ploughing with tractors, experiments at Bandjaratma in 1921 (trenches with tractors and with cable), other machines.

DE SAMENSTELLING VAN DEN AANPLANT 1921-1922 (STATISTICAL RECORD OF THE DISTRIBUTION AND COMPOSITION OF THE JAVA CANE CROP 1921-1922). *J. van Harreveld. Mededeelingen van het Proefstation voor de Java Suikerindustrie. 1922, No. 9.*

These statistics are based upon returns received from 177 out of 184 factories, or from 208,254 out of 227,648 bouws ($1\frac{3}{4}$ acres), that is 91·6 per cent. of the total area planted, and are presented in the following eight tables:—

I. The distribution of the cane varieties on each plantation in Java.
II. The same distribution in each Residency (16 in number).
III. The figures of II in percentages.
IV. The total area planted with each variety in Java.

V. The distribution and area of each cane variety used for sets, on each plantation.

VI. The same distribution in each Residency, as well as the area planted with each type of "bibit" (a) tops taken from the harvested canes (b) sets from nurseries in the plains (c) sets from nurseries in the mountains.

VII. Quantities of mountain sets used on each plantation.

VIII. The same for each Residency.

In the 1922 crop, E K 28 occupied an area of 56,800 hectares, or 39 per cent. of the total area planted in the island. The rest, in order of importance, were D I 52 (18·5 per cent.), 247 B (17·25), E K 2 (6·5), 100 P O J (4·0), 90 F (3·25), S W 3 (2·5), 2714 P O J (2·0), 2725 P O J (1·5).

PEPINIÈRES DE CANNES, LEUR ÉTABLISSEMENT ET LEUR ENTRETIEN. *G. T. A. Journal de la Station Agronomique de la Guadeloupe. Vol. II, No. 1. Point-à-Pitre, 1922.*

After pointing out the close relation between the success of the crop and the care taken in selecting the seed, the author of this note emphasizes the dangers of using old, enfeebled ratoons for seed purposes, because of the increased chances of their being infected by *Marasmius sacchari.* But he quite recognizes the objection a planter will have to spoiling the appearance and actual return of his best fields by taking tops from them, especially if he has already framed his estimates of production from them. The suggestion is therefore made of putting aside certain of the better fields definitely for seed purposes, especially such as have not had cane grown on them for several years, with careful treatment to keep out all chances of disease and to only plant the most approved varieties. Seed should only be taken from plant canes and first ratoons for the reason stated above, all sickly plants should be rejected and the seed cane should be immersed for ten minutes in Bordeaux mixture. The author refers to the experiments conducted at St. Croix, where the crops obtained from seed derived from plant canes and 1st ratoons proved superior to those obtained from 2nd and 3rd ratoons. After the crop of seed cane is reaped he advises digging up and burning the stools and planting Canavalia, Crotalaria or velvet bean as green dressing, both for improving the soil and for smothering the weeds. The soiling crop should be exposed to the air for two or three days after rooting out, to minimize the formation of organic acids after digging them in, with the corresponding tendency to encourage denitrifying bacteria, as many of the Guadeloupe estates are deficient in lime.

MOSAIC DISEASE OF THE SUGAR CANE IN THE PHILIPPINES. *H. A. Lee and E. W. Kopke. Philippine Agricultural Review. Vol. XIV, No. 4, 1921.*

A short well illustrated article intended to describe the disease so that planters may easily recognise it, with some details as to its distribution, losses caused and preventive measures. The first observation of Mosaic in the Philippines was due to H. L. LYON on a short visit in 1910 or 1911, although its presence was not apparently known by REINKING in 1920, as in *Sugar News* he then advised against its importation into the country. Although still rather local, it appears to be widely distributed and is undoubtedly spreading. Description of the disease is difficult, although a very short demonstration in the field will enable a planter to recognize it at once. It is most readily diagnosed by the pattern on the leaves of affected plants, yellow or more usually pale green blotches, often only discernible on close inspection. In badly affected plants the canes also exhibit markings. "In yellow varieties a mottling or streaking with a green or pinkish colour will

be apparent, in purple varieties mostly with yellowish or greyish white streaks." The canes are very rarely killed, the usual effect being a stunting both in length and thickness, and entire stoppage of growth is not common. The streaking is very slight in D 1135, rather marked in Cebu Purple, while in H 109 and Yellow Caledonia stunting is severe. The latter cane in the Philippines does not, however, appear to be often attacked. Losses in Cebu Purple may amount to 20 per cent., and work is being continued with the object of determining the general losses in the country.

In the Philippines the disease is being perpetuated by the failure of the cane cutters to detect it. Care should therefore be taken to instruct them. If seed can be obtained from healthy fields, D 1135 and even Yellow Caledonia are recommended, but it is not yet considered necessary to plant such poor sugar producers as Uba, Zwinga, etc.

AGRICULTURAL CONDITIONS IN THE PHILIPPINES, 1921. *Sugar Cane. Philippine Agricultural Review, Vol. XV, No. 2, 1922.*

Breaking all previous records, sugar cane succeeded rice as the second crop of the islands in value. The acreage and production of the 1920-21 campaign were, respectively, 22 and 26 per cent. greater than in the preceding year, owing apparently to the high prices ruling at the beginning of the planting season, but the value of the crop receded by 39 per cent. (*sic.*) The relative production of refined, centrifugal and muscovado sugars worked out at 5, 179, and 326 millions of kilos or thousands of metric tons; but a close comparison of these figures with those of the previous year reveals the increased influence of the centrals in the sugar industry. The quantity of refined sugar rose from less than 0·1 to 1·0 per cent., centrifugals advanced from 21 to 34, while muscovados fell from 79 to 64. With the increasing efficiency of the old centrals, and the planned construction of new ones, "there is no doubt that, within a comparatively short time, muscovado sugars will have little or no place in Philippine production." Four provinces—Occidental Negros, Pampagna, Batangas and Iloilo—accounted for 67 per cent. of the total area and 76 per cent. of the production. As is usual in these annual reports, a map of the islands gives the relative distribution of the sugar industry, and it appears to be concentrated in two main areas, leaving the great bulk comparatively untouched, although we believe that sugar might be grown if conditions were favourable in most parts of these rich islands. A table is appended giving the total area cultivated and sugar and *panocha* produced, year by year, from 1910 to 1921. During this period, the area increased from 83,168 to 241,345 hectares, while the sugar produced increased from 153 to 510 million kilos. *Panocha* only showed a slight increase.

C. A. B.

R. VACHIER[1] discusses the profit to be made in manufacturing white granulated by means of carbons, as compared with the production of 96° raws. A standard white granulated house should have a recovery of 92·5 per cent. of 96° raws, so that a house obtaining 160 lbs. of 96° raws per ton of cane should recover 148 lbs. of white granulated. Assuming that white granulated made from carbon sells at 5 points below that made by boneblack, and taking the prevailing prices in Louisiana as \$5·25 for raws and \$7·00 for granulated, then the gross proceeds for the two are (160 × \$5 25) = \$8·40 and (148 × \$7·00) = \$10·36. He says that it costs about \$1·00 to make one ton of cane into raws, and about \$1·75 to manufacture one ton of cane into white granulated using carbon, so that if this is so the proceeds in the case of the raws would be (\$8·40 — 1·00) = \$7·40; and in that of the white granulated (\$10 36 — 1·75) = \$8·61, a difference of \$1·21 per ton of cane in favour of white granulated.

[1] *La. Planter*, 1922, **69**, No. 26, 471.

Progress made in Sugar Manufacture and By-product Utilization in Hawaii.

Mr. HORACE JOHNSON, Chairman of the Committee on the Manufacture of Sugar and Utilization of By-products, has presented his Report to the President and Members of the Hawaiian Sugar Planters' Association, for the year ending September 30th, 1922, of which report the following is a summary. Appended to the report are several particularly interesting articles; one dealing with the Thomas and Petree process has already been published.[1] Summaries of the other useful papers will be given later.

CLARIFICATION.

This subject has received but little study or attention in the Hawaiian Islands, having been a "hit or miss" method of treatment of the raw juice with lime and heat. This station at most factories is not equipped to allow of the careful and accurate liming of the juice, and the juice from a few loads of "pick-up" cane receives the same liming as juice from freshly cut cane; while the juice from a few loads of Yellow Caledonia receives the same treatment as that from H 109 cane. The correct limits of alkalinity or acidity for different canes or conditions, whereby the clearest juice may be obtained, the maximum recovery of sucrose, the minimum loss due to inversion or destruction of sucrose, are not known.

Regarding the effect of our present methods of clarification on the refining qualities of the raw sugar; and the changes in routine what might be made to improve the refining qualities of raw sugar, Mr. MCALLEP and Mr. BOMONTI of the Experiment Station have been making preliminary studies. Definite information can be and should be obtained as to the effect that "cush-cush" and other suspended solids in the juice have upon its purity, viscosity, and filtering qualities; the effect of clarification on the colour of raw sugars; the best methods of clarification whereby inversion and destruction of sucrose can be prevented, and the maximum recovery of sucrose be obtained; the effect of clarification on the refining value of sugar, etc.

Reports on the methods of clarification which are now followed by the plantations have been compiled by Mr. MCALLEP.

SUGAR BOILING.

Under this section Mr. WM. SEARBY has outlined the process of boiling low grade products as followed by most of the mills in these Islands. No new methods have been employed during the past year. The majority of the factories are using, with slight variations, a system of one marketable sugar strike into which is boiled-back molasses and low grade sugar remelt or seed, and one low grade crystallizer strike which produces the above mentioned low grade remelt or seed and a final molasses. By this method, a marketable sugar of approximately 97·0° polarization and a final molasses of 36 to 38° gravity purity can be produced. There is a minimum of products of different purities to be kept separate, and taking it all in all it is probably the easiest method to handle and control.

The marketable sugar is built up in a rather impure mother liquor and there is a considerable re-processing of low grade non-sugars. Too often the low grade sugar which is returned to the marketable sugar pan is of very low purity. On account of these objections, it is advisable to study other methods of boiling which would permit of the marketable sugar being grained and built up in a mother-liquor of the highest possible purity, and reduce the re-processing of non-sugars to a minimum.

[1] *I.S.J.*, 1923, 26.

QUALITY OF RAW SUGAR.

The plantations have produced a sugar of about 97·0° polarization. For average working conditions, this polarization has been an economical grade to produce, both from the plantation and refinery viewpoint. The observations of the technical men of these Islands, and also of the refinery staff, are that the quality of grain produced during 1922 is not as good as that produced during 1920 and 1921.

Mr. W. R. McALLEP reports that: "The quality of the grain, however, both with respect to size and conglomerates, is the principal factor influencing the amount of water required for the preliminary washing of the sugar at the refinery. At Crockett the raw sugar is washed to a standard purity of 99·0. Though the amount of water required should have been less after the increase in polarization, actually an increased amount has been required, indicating a much poorer grain than in 1920. In this connexion the writer would note that determinations of the size and shape of the grain made in the course of factory inspection work had previously convinced him that the average quality of the grain was much poorer than in 1920. Keeping the grain up to the standard, providing the factories are adequately equipped, involves careful and intelligent handling of the pans rather than any considerable extra expense. As it is also probable that any necessary expense in keeping the grain up to the standard is fully offset by increased recoveries realized as the result of more care and attention given to the boiling process, it is questionable whether allowing the quality of the grain to deteriorate has resulted in any savings at the plantations. The increased amount of water necessary at the refinery affination station amounts to 8 or 10 lbs. per ton of raw sugar, an increase of some 12 per cent. The evaporation of this extra water entails a considerable extra expense at the refinery. As individual plantations are now directly affected by anything that increases the refining cost, it would seem desirable to bring the grain back at least to the 1920 quality. Lumps of hardened massecuite and also caked sugar affect the amount of water required for washing, but it is improbable that these are important factors in the increased requirement noted above. A year ago the writer considered that the commercial sugar control carried on at this Station for several seasons was no longer necessary, as the plantations should have sufficient information to maintain the quality of the grain, particularly as grain separations were available on request. Discontinuing the control, however, has created the impression in many quarters that it is no longer particularly essential to keep the grain up to the standard. The writer now considers it desirable to make a sufficient number of grain separations, either at Crockett or the Experiment Station, so that definite figures for the quality of the grain may be available. An investigation of the cause of conglomerate grain is also desirable."

H. C. WELLE regarding this problem writes: "Since 1917 the grain of Hawaiian raws, as regards its size, has been very much better for refining purposes than prior to that time. However, there appears to have been some inclination in certain cases to retrograde in this respect during 1921 and 1922. Unfortunately our Laboratory has discontinued the screening test as a regular routine and is not in a position to speak as authoritatively on the subject as the Experiment Station, which has maintained such a control. We are not inclined to criticise the size of the grain so much as the inclination to slip back to a slightly poorer standard in some instances. Although we are no longer making systematic observations on the quality of the crystal itself, we are inclined to believe that the dark seed grain has practically disappeared from Hawaiian raws. It is desirable

for a raw sugar to be as free of conglomerate grain as possible, as it is obvious that such grain is much more difficult to wash properly than free crystals. The averages for the past four years show little change for the better, although some of the sugars have shown a creditable improvement in this respect, thus indicating that the condition can be controlled to a certain extent and that it might be possible to furnish us sugar with less conglomerate grain than has been the case in the past."

Complaints have been made by Crockett Refinery from time to time on the condition in which the raw sugar from the Islands is received. The chief cause of additional trouble and expense is due to caked sugar; and Mr. W. DUKER has obtained letters on this subject from the different plantations. While some have apparently reduced the cause or have eliminated this trouble, actual information on this subject is not very definite. The strength and prosperity of the plantations of the H. S. P. Association depend directly and entirely upon the profits of an enterprise which starts with the raising of cane in the fields in the T.H. and finishes with the marketing of refined sugar in the United States. The costs of this enterprise consist of: (1) The cost of producing the raw material, sugar cane. (2) The manufacturing costs of separating the sucrose from this raw material, purifying it, and producing it in such a quality and in such packages as the market may demand. (3) The cost of distributing and selling the finished product to the consumer.

The success of the enterprise depends upon the margin between the total costs of all three operations and the selling price of the finished products. It is obvious that these three operations cannot be considered separately. They must be closely linked together, so co-ordinated and so conducted that we are producing and selling the maximum amount of refined sugar per acre at the least possible cost. Is the production of raw sugar carried on in the most economical manner? Are the methods used the best methods? Is the quality of the raw sugar the best that can be made in order that the further purification, refining, may be carried on in the most economical manner?

Ten main characteristics which affect the refining quality of a raw sugar are given in a report by the California and Hawaiian Sugar Refining Corporation, and are as follows: (1) Polarization; (2) ash content; (3) deterioration factor; (4) grain; (5) dark seed grain; (6) conglomerate grain; (7) colour; (8) sulphates; (9) "filtrability"; and (10) caked and sticky raw sugars.

Hawaiian sugar can be considered fairly satisfactory in regard to: (1) polarization; (3) deterioration factor; (4) grain; and (5) dark seed.

Taken as whole there is not much trouble encountered in respect to: (6) conglomerate grain; (7) colour; and (10) caked and sticky sugar, although improvements would be very beneficial especially in regard to the sugars from certain plantations.

On the other hand, Hawaiian raw sugars cause trouble and expense in the refining process, due to: (2) ash; (8) sulphates; and (9) "filtrability": And the most urgently desired improvement in the manufacture of Hawaiian raws from the standpoint of this refiner is in their "filtrability."

This report suggests that other investigations be made which might result in obtaining information that would not only improve the quality of raw sugar but might at the same time increase the yield. Such investigations should cover: (1) factory balance; (2) colour decrease and increase at various stages; (3) gummy constituents and their possible diminution; (4) suppression of the development of ferments; and (5) study of crystallization in respect of shape and uniformity of grain.

These are all technical questions upon which we have very little definite knowledge. Accurate information on these subjects would be of great guidance in the manufacture of a better quality of raw sugar.

A committee of technical men might be appointed to confer with the Experiment Station staff in drawing up an outline for the carrying out of such investigations.

UTILIZATION OF BY-PRODUCTS.

This subject has been so carefully covered in the reports of the last few years that there is nothing new to add. During the past year there had been no demand on the Coast for this waste product, and but little has been sold, so that the disposal of the waste molasses is still an urgent question. The plantations have fed the usual amount to stock, and have burned the surplus molasses either in the bagasse furnaces or in special furnaces whereby a larger amount of potash could be recovered.

With a large amount of molasses of low value on hand, the question of converting this molasses into motor fuel or stove alcohol for the plantations arises. In a very complete report, Mr. AGEE and Mr. MCCLEERY, of the Experiment Station, have covered the question of manufacture of industrial alcohol from Hawaiian molasses. Assuming average costs for installation and operation, it is shown that there is not much margin for profit in producing motor fuel or stove alcohol in competition with gasoline at 25 cents, and kerosene at 17 cents a gallon.

Control of the Reaction of Juices and Syrups by the Determination of the Hydrogen-ion Concentration.[1]

H. F. BREWSTER and W. G. RAINES, Jr.,
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DEFINITION OF HYDROGEN-ION CONCENTRATION.

When a substance, such as an acid, a base, or a salt, is dissolved in water, it is split into two parts bearing electrical charges of opposite signs. Thus: $HCl = H^+ + Cl^-$. $NaOH = Na^+ + OH^-$. $NaCl = Na^+ + Cl^-$. This is called dissociation or ionization.

There is a difference in the extent to which substances dissolved in water are ionized. An N/10 solution of acetic acid, for example, is only about 1·3 per cent. dissociated into H^+ and $C_2H_3O_2^-$ ions, while an N/10 solution of hydrochloric acid is nearly 95 per cent. ionized. There remain 98·7 per cent. acetic acid undissociated in the first case and 5 per cent. in the case of hydrochloric acid. While both solutions require the same quantity of standard alkali to neutralize them, there is a great difference in their "strength," and this is determined by the extent to which they are ionized.

The comparative power of different acids to invert sucrose, as shown in the table of BROWNE,[2] is also a measure of their strength or of the extent to which the different acids at given concentration are dissociated.

[1] Paper presented before the Division of Sugar Chemistry at the 63rd Annual Meeting of the American Chemical Society, Birmingham, Ala., U S.A., April, 1922. See also *J. Ind. Eng. Chem.* 1921, **13**, 1043; KLOPSTEG, *Ibid.*, 1922, **14**, 399; *I.S.J.*, 1921, 702.

[2] "Handbook of Sugar Analysis." C. A. BROWNE. Page 663. (Chapman & Hall.)

The above may serve to point out the distinction between titratable acidity and "activity" of an acid due to its dissociation into H-ions and negative ions. Both "acidity" and "activity" are expressed in terms of normality. In the case of titratable "acidity" the total actual acid is measured, while in measuring "activity" the amount of dissociated hydrogen-ions is measured and this is expressed in terms of normality or fractional normality as $\log = \frac{1}{[H^+]}$ or pH.

Even water is very slightly ionized, thus: $HOH = H^+ + OH^-$, but in this case there are an equal number of H^+ and OH^- ions free at any given temperature. Thus in one litre of water at the ordinary temperature there is one ten million grm.-molecule of H-ions, more simply written as 1×10^{-7} grm.-molecule, Water is, therefore, 1×10^{-7} normal with respect to H-ions, and the same as to OH-ions, the total ionization being 1×10^{-14}. When neutral salts are dissolved in water, this proportion is not disturbed; but when an acid is dissolved there is an excess of H-ions over OH-ions. On the other hand, when a base is dissolved in it the OH-ions are in excess. However, no matter how many H-ions are present there are always present a sufficient number of OH-ions to preserve the above relationship of 10^{-14} for the total number of ions. If the H-ion concentration of a solution be 1×10^{-4} normal, or pH = 4, the concentration of the OH-ions will then be 1×10^{-10}, or pH = 10.

METHODS FOR THE DETERMINATION OF THE HYDROGEN-ION CONCENTRATION.

There are two ways for the determination of the H-ion concentration, viz., the electro- or potentiometric, and the colorimetric. Of these two, the former is by far the more accurate, but the apparatus requires the attention of an expert to operate it, and to keep it in working order.

Electro- or potentiometric method.—When a hydrogen electrode, consisting of a platinum foil or wire coated with platinum or palladium black saturated with pure hydrogen gas is immersed in a solution containing hydrogen ions, an e. m. f. or potential is set up between solution and electrode proportional to the concentration of hydrogen ions in the solutions. By measuring this potential, the concentration of H-ions can be calculated. There is no direct way of measuring the potential; but if liquid contact be made between the test solution and another solution whose H-ion concentration (hence voltage) be known, the total voltage may be measured; and, after deduction of the known voltage, that of the unknown remains, and may be calculated to H-ion concentration. Then the simple formula of CLARK[1] may be used: $\frac{\text{Potential difference}}{\text{Numerical factor}} = \log \frac{1}{[H^+]}$. H^+ being the symbol for the H-ion concentration expressed in terms of normality (grms. of H-ion per litre). Instead of solving for $[H^+]$ it has become customary to represent hydrogen-iron concentration by $\log \frac{1}{[H^+]}$, to which expression (as just mentioned above) has been given the symbol, pH.

As the hydrogen electrode is useless in the presence of free SO_2, it cannot be employed for the control of sulphitation. Moreover, suspended impurities, as well as more disperse material occurring in cane juice, cause the rapid fouling of electrodes, necessitating frequent changes, and the occasional checking of the method

[1] "The Determination of Hydrogen Ions." By W. MANSFIELD CLARK (Williams & Watkins Co., Baltimore, U.S.A.). 1920. See *I.S.J.*, 1921, 103. This excellent book contains a discussion of theory; description of methods; and examples of practical application, with a biography.

by means of indicators. On the other hand, with clarified juice, the electrometric method is extremely satisfactory, and might be employed in the manner described by KEELER.[1]

Colorimetric Methods.—For sugar-house control, the colorimetric method is preferred. It is easy of operation and rapid; and the accuracy attainable is entirely satisfactory as determined by checking against the hydrogen electrode. Furthermore, the procedure is almost as simple as the use of litmus paper, thus rendering the method sufficiently safe and easy to be taught to operatives who possess intelligence enough to be entrusted with the supervision of sulphuring or liming. It depends upon the changes of colour or of hue which occur when solutions of various indicators are subjected to graduated changes of H-ion concentration. Most indicators show maximum colour change within only a short pH range.

In order to cover an extensive range several indicators must be used, so chosen that the range of one may meet or slightly overlap the range of the next.

Indicators are weak organic acids, capable of forming salts. In solution these dyes are dissociated in exactly the same manner as inorganic acids or salts and their anions have colours different from those of the dissociated acids. In alkaline solution the indicator exists in the form of a salt which is completely dissociated. In acid solution the free acid only is present which is but little dissociated, this dissociation being depressed if an excess of hydrogen ions is present. At hydrogen ion concentrations between that at which all the indicator exists as free acid and that at which it exists entirely as salt, there will be mixtures of salt and undissociated acid, consequently mixtures of colour. The familiar methyl orange may be taken as example: The undissociated acid in acid solution is red, while the fully neutralized and dissociated salt is yellow. Between these extremes there will be mixtures of red and yellow, each varying shade of orange corresponding to some definite hydrogen ion concentration. So with other indicators. This is the basis of colorimetric methods for determining H-ion concentration.

The set of indicators selected by CLARK and LUBS[2] has met with general favour in this country, and their names, concentration at which employed, colour change and pH range are given in the following table:—

	Concentration, grms. per 100 c.c.	Colour Change.	pH Range.
Thymol blue	0·04	Red-yellow	1·2—2·8 8·0—9·6
Brom phenol blue	0·04	Yellow-blue	3·0—4·6
Methyl red	0·02	Red-yellow	4·4—6·0
Brom cresol purple	0·04	Yellow-purple	5·2—6·8
Brom thymol blue	0·04	Yellow-blue	6·0—7·6
Phenol red	0·02	Yellow-red	6·8—8·4
Cresol red	0·02	Yellow-red	7·2—8·8
Cresol phthalein	0·02	Colourless-red	8·2—9·8

The writers use methyl orange in place of brom phenol blue. Its concentration is 0·02 grms. per 100 c.c. and pH range 3·1–4·4. The indicator solutions should be kept in dropping bottles or in bottles provided with dropping pipettes.

The procedure adopted by the writers for the colorimetric determination of pH in sugar liquors known as "spotting." This consists of adding one drop of the appropriate indicator solution to three drops of the test liquid contained in the depression of a porcelain spot plate. Against the white background very slight differences in hue may be detected. The colour developed in the test spot after the

[1] *Facts about Sugar*, 1921, **12**, 490. [2] *Jour. Wash. Acad. Sci.*, **6**, 609.

indicator and test liquid have become mixed is matched with similar spots made by adding a drop of the same indicator to three drops of a standard buffer solution. The pH of the standard buffer which matches the test solution in hue is then the same as the pH of the test solution.

The standard buffer solutions for the colorimetric method are mixtures of an acid with one of its alkali salts and are made up in series to furnish graduations of 0·2 pH. An example is the acid potassium phthalate, addition of alkali to which will reduce its H-ion concentration due to the neutralization of a part of the acid salt while the addition of a strong acid such as hydrochloric will increase it. The increase of H-ion concentration in this case is not due to the dissolution of HCl, which would gives increases too great to be readily controlled, but to the dissociation of the weaker phthalic acid replaced by the hydrochloric. CLARK and LUBS devised a set of buffer solutions wherein they employed solutions of certain salts to which were added acid or alkali in varying quantities so as to give solutions graduated in 0·2 pH.

The buffer solutions may be made up according to the list of CLARK and LUBS[1] or that of MCILVAINE.[2] Standard buffers in tablet form may now be purchased,[3] and are made up to give graduations in 0·2 pH, requiring only to be dissolved in pure water.

APPLICATIONS IN THE SUGAR-HOUSE.

For controlling reaction in the sugar-house only a few indicators and buffers are required, and it is possible to dispense with the latter since standards for end-points may be established in another manner.

In liming juice it is advisable to bring the final juice reaction to as near true neutrality as possible. By the titration method of control the juice is brought to about 0·2 to 0·3 phenolphthalein acidity. This point may be very readily determined by the use of a single indicator from the list given above, namely, phenol red. Phenol red has a useful range of pH 6·8 to 8·4. That is, from just a trifle acid to distinctly alkaline, the colour change from acid toward alkaline being from yellow through varying shades of orange to deep red in the spot test. The slightest change, then, of the colour of phenol red from yellow toward pale orange will indicate a very close approximation to neutrality. The proper buffer solution for neutrality is pH 7·0. If this is spotted with phenol red, a colour standard is established; and in order to lime to neutrality the liming is stopped when the hue of the test spot matches the hue of the pH 7·0 buffer. For continuous liming the flow of lime may be controlled in the same manner.

The course of liming may be followed by use of brom thymol blue or brom cresol purple by spotting in the same manner. The latter being particularly valuable for the reason that its useful pH range begins with yellow at the acid end, near the pH of normal cane juice and ends with its deepest purple just before neutrality is reached. If the juice be limed to the point where the deepest purple occurs with brom cresol purple, and phenol red barely shows a change or deeping of hue, one may be certain that the point of true neutrality is attained to within very narrow limits.

There seems to be no useful purpose in liming beyond pH 7·0. DEERR[4] concludes that a juice acidity of 0·25 to 0·5 c.c. appears to fulfil the conditions demanded by a good defecation. His experiments consisted of treating juice with milk-of-lime to various decreasing acidities and noting the rate of settling, volume

[1] *Ibid.*, page 69. [2] *Jour. Biol. Chem.*, 1921. 49, 183.
[3] The Pyroelectric Instrument Co., Newark, N.J.
[4] "Cane Sugar," NOËL DEERR, 2nd Edition, page 271. (NORMAN RODGER, London).

of mud, method of separation of the precipitate, and clearness of supernatural liquid. His acidities correspond to about pH 6·8 to 7·0. After limed juice is settled and the defecated supernatant liquid decanted, more lime is often added to the mud to facilitate filtration. This alkaline filtrate is much darker than the decanted neutral juice. This may be avoided by use of an inert filtering medium in place of an excess of lime.

In the sulphitation process as performed in Louisiana, cane juice is treated with sulphur dioxide until a titratable acidity of about 5·0 c.c. is reached. Milk-of-lime is then added and the acidity reduced to a point at which there is little or no danger of inversion, when the juice is heated, settled and decanted and the mud filtered, or better still, the entire defecated juice filtered. Practice varies somewhat as to the final acidity of juice in the sulphitation process, some preferring a somewhat high acidity, around 1·0 c.c. others reducing it to about 0·5 c.c., the object being to leave the juice slightly acid in reaction to avoid the darkening effect which occurs if liming is continued. Danger of serious inversion is practically nil at such acidities.

The end point for sulphuring may be determined with methyl orange or brom phenol blue. The H-ion concentration corresponding to 5·0 c.c. acidity being close to pH 3·8. The pH 3·8 buffer may be used for establishing the orange shade for comparison and the juice is spotted frequently during the course of sulphuring until the test spot corresponds in hue with the standard.

Another method for establishing a standard for comparison is to sulphur to the desired acidity as usual by titration. A small sample of this sulphured juice preserved in a well stoppered bottle may then serve as the standard for spotting. It should be remembered that both acidity and hydrogen ion concentration of solutions of sulphurous acid decrease on keeping due to loss of SO_2. The standard should therefore be renewed frequently.

The end point for liming back sulphured juice, if neutrality is decided upon, may be found exactly as in the case of liming raw juice, by means of brom cresol purple and phenol red, with or without the aid of the pH 7·0 buffer.

The degree of final acidity at which sulphured juice should be left has received much discussion. CROSS has shown that it is possible to carry much higher titratable acidity without serious risk of inversion if the raw juice be sulphured to high initial acidity. The factors determining extent of inversion are concentration of hydrogen ion, temperature and time of reaction. CROSS found that in the case of juice sulphured to 8·0 c.c. acidity, a final acidity as high as 4·0 c.c. could be carried and the juice heated under vacuum of 20 ins. of mercury with very little inversion occurring. This is easily explained upon grounds of hydrogen ion concentration. If one follows the course of the addition of sulphur dioxide to cane juice by titration of the acidity and determination of pH (with methyl red, then methyl orange), it is found that a very considerable quantity of SO_2 is taken up before the methyl red begins to deepen in colour. This is due to the fact that the first action of the sulphurous acid which is a "strong" acid is to unite with bases present combined with the weak organic acids of the cane juice. These organic acids are but little dissociated, hence the H-ion concentration is but little affected by their accumulation. This is a typical example of buffer action. Immediately the organic acids have been completely replaced in their salts by sulphurous acid, the latter on continued addition now being the free acid and highly dissociated shows its effect upon the H-ion concentration which increases rapidly. Therefore a great part of the titratable acidity of a moderately sulphured cane juice may be attributed to organic acids.

[1] *I.S.J.*, 1913, 436; and NOËL DEERR has also dealt with this point. See *I.S.J.*, 1911, 105.

Before leaving the subject of the possibility of serious inversion in the working of acid juices it is of importance to cite the results obtained by ZERBAN who carried juice at natural acidity through processes of treatment with kieselguhr and decolorizing char, with subsequent evaporation and boiling to grain without serious loss due to inversion. The raw juice acidities varied in Zerban's experiments from 0·62 to 1·33 c.c. We have found in two seasons experiments that the hydrogen ion concentration of raw juice lies close to pH 5·0 and that this value does not depend upon the amount of free acids as determined by titration. It is assumed that the raw juices of Zerban's experiments had practically the same pH value as those found by us. It would therefore appear safe, in view of the results of CROSS and ZERBAN to work juices at fairly high titratable acidities, in so far as serious inversion is concerned. It is doubtful to the writers, however, that extreme acidities are of advantage in the sulphitation process, the only advantage apparent being that of paleness of colour of the clarified juice. Certainly all acidity due to sulphurous acid should be neutralized for two reasons: First, the greater the quantity the calcium sulphite that may be formed from the sulphur dioxide added, the greater is the ease of filtration. Second, any calcium bisulphite left in solution due to insufficient liming will break down during evaporation with liberation of sulphurous acid in the condensed water and precipitation of normal calcium sulphite and consequent scaling upon the heating surfaces of the evaporator bodies.

A mild sulphitation is employed to some extent in Louisiana for the manufacture of high grade raw sugar, a great quantity of which is refined with vegetable char. In this process, which is very suitable to Louisiana cane and economical because of the cheapness of sulphur and lime, the juice is sulphured to 3·5 to 4·0 c c. acidity and limed back. Slight final acidity is not to be considered objectionable in this treatment.

SUMMARY.

The object of treating cane juice with lime alone is to flocculate and precipitate impurities. This flocculation occurs in normal juice within rather narrow limits of H-ion concentration close to true neutrality, about pH 6·8 to 7·0. When sulphitation followed by liming is employed, calcium sulphite is formed which precipitates on heating, carrying down impurities by adsorption. It follows that in liming a sulphured juice all the sulphurous acid should be neutralized in order to furnish the maximum amount of calcium sulphite from the sulphurous acid present, consequently the maximum amount of adsorbing surface. A further addition of lime somewhat beyond this point assists in the settling by flocculating the impurities, just as it does when lime alone is used. Lime should not be added beyond neutrality; in fact, acidities corresponding to pH 6·0 are permissible if the clarified juice be not held at high temperatures.

During the past season in Louisiana several factories used "Carbrox" (or rice-hull decolorizing carbon) in the manufacture of white plantation sugar,[2] by applying this preparation to the purification of the liquor obtained by remelting washed raw sugar, the partly exhausted preparation being filtered off, and used later for the clarification of the raw juice, being finally thrown out with the filter-press mud. It is claimed that this method operated successfully, and was economical under the conditions prevailing.

[1] Bulletin 173, La. Sugar Experiment Station, 1920.
[2] *La. Planter*, 1922, 69, No. 26, 462.

Value of Kieselguhr for the Filtration of Cane Juices.

"Suma-sil" Grade in Mauritius.

In a recent note in this Journal,[1] it was remarked that it is singular that so far the value of kieselguhr as an aid to filtration has not been realized to the extent that it merits by the manufacturer of raw cane sugar, though refiners use it largely. Experiments carried out in different countries in factories experiencing more or less difficulty in the filtration of their slimy muds have shown that the addition of kieselguhr gives cakes that are much harder, and are capable of being washed down to a low sucrose content with ease. A good number of factories are now using this material regularly, and with the most satisfactory results.

It was also pointed out that there are a number of different grades of kieselguhr on the market at the present time; but that it is safe to say that some (particularly those containing a high proportion of clay) are totally unsuited for the filtration of cane juices and syrups. The use of such grades causes difficulty in different ways, and can lead only to disappointment. Good results have been obtained by the use of the grade known by the name of "Suma-sil,"[2] the value of which in practice has now been proved.

Importations of this preparation into Mauritius have been made; and a report on a sample of "Suma-sil" has been made by Mr. P. de Sornay, Editor of *La Revue de l'Ile Maurice*, a chemist of repute, whose name is well-known to our readers. He found its composition to be as follows: Water, 8·16 per cent.; loss on heating, 2·12; silica, 80·00; lime, 2·02; iron and alumina, 5·30; magnesia, traces; and undetermined, 2·40 per cent. Hence, the silica content when calculated on the dry matter is about 87·2 per cent. Mr. de Sornay then made the following remarks:—

"The results of this analysis indicate that the product is kieselguhr. Seeing its extreme state of division, it would seem that it is specially prepared for use in the defecation of juice. This product, in fact, is a white, impalpable powder, which is light in weight, representing a rather large volume. Kieselguhr has been tried to advantage in Mauritius by Mr. A. Dalais, and by our colleague Haddon at Labourdonnais. We have not had any personal experience of its application; but we can recommend it, knowing that experiments have been made with it with success in the West Indies, Natal, Australia, and elsewhere. It is generally employed in the acid juice to the amount of 2-3 lbs. per ton of cane. It has the property of removing matters in suspension, and perhaps even may act in part on the colloids. After treatment, filtration gives a brilliant limpid liquid, making it possible to effect the crystallization of the sugar in a purer medium. In Mauritius lime is employed for facilitating the filtration of the scums; but the alkaline juice thus resulting has certain serious defects. Kieselguhr advantageously replaces lime for this purpose, either partly or entirely. Regarding the quantity to be used, we cannot state this, because it will vary according to the nature of the scums, though the first trial might be made with 1 lb. for a tank holding ten barriques. If the price of this product is commensurate with its advantages, we recommend its trial."

Anyway, it is certain that the addition of lime to the mud previous to filtration is a very faulty procedure, since it causes glucose destruction, and thus adds greatly to the colour of the juice. "Suma-sil" not only obviates this colour formation, but even with very gummy juices gives a more porous cake, instead of a slimy one. Its use in the manner indicated above does not form an appreciable item of cost, and its value in the ease of filtration and in the saving of sugar by the exhaustion of the press-cake cannot be overestimated.

[1] *I.S.J.*, 1922, 148.

[2] It is sold by The Sugar Manufacturers' Supply Co., Ltd., of 2, St. Dunstan's Hill, London, E.C. (Cable address; "Sumasuco, London"). When first put on the market, it was called "Suma-cel," but the trade name "Suma-sil" has now been adopted.

Department of Overseas Trade Reports.

PERU.

Sugar.—The area under cane is given as a little more than 100,000 acres. No exact estimate can be made of the production for 1921: it was probably under 300,000 tons. It is considered that the production in 1922 will prove to be more than sustained. The present price of 12s. 6d. per quintal f.o.b. Peruvian port, although seeming extremely small compared with the record of 111s. 6d. obtained in June, 1920, still probably yields a margin of profit to the producer.

CUBA.

Sugar.—Shortly after the 1920 disaster, when the sudden fall in the price of sugar found Cuban holders with immense stocks unsold, the 1921 crop of 3,922,267 tons was thrown on to the market, which made still more confusion. A Government Commission took control of sales until December, 1921. This Commission fixed a minimum price at about 3 cents a lb., thereby arousing a great deal of antagonism. In addition the Fordney tariff proposals upset the market. A Cuban commercial mission visited Washington to negotiate the reduction of the Fordney duty and numerous proposals were put forward to this end. The general view was that it was desirable to limit the Cuban sugar crop so as to lessen competition with the American product; other views were based on alterations of the Cuban tariff in the same interests. The "Sugar Export Corporation" under the "Webb Export Trade Act" had a contract with Cuban producers for refining certain quantities of sugar in bond for re-export, and this should be of advantage to the Cuban producers. After the removal of Government control the price of sugar rose, and demand increased both from Europe generally and from the United Kingdom, while purchases were also made by China and Japan.

But about 88 per cent. of the Cuban sugar finds its market in the United States, where it enjoys a 20 per cent. rebate over other foreign-grown sugars. American interests control about 54 per cent. of the crop, a proportion which is largely increased by the advances made by American banks during the recent crisis, whereby temporary control, which may become permanent, passed out of the hands of the non-American holders. One of the factories has recently produced its millionth bag, a record for Cuba.

Great Britain is a good customer of Cuban sugars, importing more from Cuba than from her own possessions.

ARGENTINA.

Sugar.—Production in the different sugar zones of the country during each of the last three years was as follows:—

LOCALITY.	1919. TONS.	1920. TONS.	1921. TONS.
Tucuman	246,111	161,500	163,000
Jujuy and Salta	39,744	33,622	28,000
Other Provinces	5,562	2,939	3,000
Total, metric tons	291,417	198,061	194,000

The 1922 harvest is expected to yield 200,000 tons, crushing operations having proceeded satisfactorily, without much damage by frost. As there was an estimated stock of sugar in the country at the commencement of the harvesting season of 52,000 tons, and further importations have been made, it is anticipated that there will be a fairly considerable surplus over home consumption, which is some 220,000 tons annually, and the market is somewhat depressed. Argentine sugar was re-imported from the United States and Uruguay during 1921 under special permits. Argentina is not normally an importing country, the local industry having a special tariff protection, but owing to the low cost of Cuban sugar refined in the United States and the bounty system of Brazil, there were heavy exports in 1922. The following are the totals in metric tons of re-imported Argentine and imported foreign sugars during the eighteen months ended 30th June, 1922: United States, 54,041; Brazil, 43,534; Uruguay, 12,766; other sources, 2,088; total, 112,429. Firmer prices in the United States have caused shipments from that source to be

suspended, but as there has been a large harvest in Brazil imports at low prices from that country are expected to continue.

With the object of encouraging the production of beet sugar, the Government of the province of Cordoba has granted a subsidy of $600,000 paper, payable in ten annual instalments, to a local industrialist who undertakes to construct within four years a factory capable of producing 6000 metric tons of beet sugar annually.

ALGERIA.

Although French sugar entering Algeria pays a duty of only 50 centimes per kg. as compared with a duty of one franc for foreign sugar, French imports are comparatively small, and most of the sugar imported—particularly cubes and granulated—comes from the United States. Delivery is always c i.f. Algiers or any other Algerian port. Importing from the United States is considered unsatisfactory, since the shipments are frequently a month or six weeks *en route* owing to the steamers calling at other ports on the way, and there would be a large market for British sugar if British manufacturers would agree to quote c.i.f. prices—a proceeding which they at present refuse to carry out—and be willing to sell without the interference of middlemen. The practice in the sugar trade is to open irrevocable bank credits with each order, so that there is no difficulty regarding payment. Czecho-Slovakia is expected to be a keen competitor in this market in spite of the fact that one of their largest sugar export companies is at present in liquidation.

VENEZUELA.

Exports of sugar, refined and unrefined (papelón), which before 1916 were very small, reached a total of 17,382 tons, valued at Bs. 7,848,371* in 1919, and 18,811 tons, valued at Bs. 17,920,272, in 1920, to fall away again to 13,782 tons in 1921, valued at Bs. 5,299,472. In present conditions, which appear to be more or less permanent, there is little chance of Venezuela being able to compete to any considerable extent in the world markets for this produce. The home market, however, provides a fair return on native capital invested in the industry, especially in the Federal District, and the States of Miranda, Aragua, Carabobo and Zulia.

Australian Sugar.

The Government Control, 1915-1922.[2]

In June, 1915, the Commonwealth Government assumed control of the Australian sugar output, paying the growers a fixed price of £18 per ton of raw sugar, subsequently raised in 1917 to £21. The Commonwealth Government disposed of the refined product at an average of £25 10s. per ton in 1915, the object then being to enable the consumer to purchase sugar of 1A grade at 3d. per lb. In January, 1916, however, the wholesale price was raised to £29 5s per ton, and the retail price to 3½d. per lb. This arrangement was continued from year to year until 26th June, 1920, when an agreement was made with the Queensland Government for a period of three years, covering the seasons of 1920, 1921, and 1922, fixing the price of raw sugar for the first year at £30 6s. 8d. per ton, and making that price the minimum for each of the succeeding seasons, any increase being limited to the extra cost of production, due to higher wages paid to the sugar workers to meet the increased cost of living. In order to recoup the Commonwealth Government for the loss entailed in the purchase at very high prices of large quantities of foreign sugar, owing to the shortage of the Australian crop, the wholesale price of refined sugar was raised on 25th March, 1920, to £49 per ton, and the retail price to 6d. per lb., at which price sugar is being sold to-day.[3]

* £1 = 25·25 Bolivares.

[2] From "Report of the Economic and Financial Situation of Australia," to October, 1922 (Dept. of Overseas Trade Report, 1922).

[3] Since this Report was written, the price has been reduced to 5d. per lb.

Publications Received.

Die Zucker-Fabrikation. By Dr. H. Claassen. Fifth Edition. (Schallehn & Wollbrück, Magdeburg, Germany.) 1922. Price: 20s.

Claassen's exposition of beet sugar manufacture, which combines both theory and practice in a singularly able manner, is well-known to English readers through the medium of a translation by HALL and ROLFE, the last version of which was published in 1907. But since that date a fourth German edition has appeared, and now such has been the demand for this important work that after the comparatively short interval of four years a fifth edition is necessitated. On comparing these last two German editions with the third (from which the last English translation was prepared), it is seen that the book has been amplified throughout; additions have been made to various sections here and there; while certain portions, such as those dealing with diffusion and evaporation, have been largely re-written. Also in the appendices one now finds new data and tables, the most important of which treat of: the calculation of the steam requirements of a beet factory slicing 100 kg. per hour; a comparison of the steam and coal consumption in different systems of evaporating and heating; and particulars of the German beet industry since 1839-40, regarding factory capacity, yield, prices, and *per capita* consumption. Then on comparing the fifth with the fourth German edition, the new matter mostly concerns: slice drying with flue gases; juice-heating by Brukner's method of using injection condensers; separation previous to liming proper of a precipitate rich in protein and phosphoric acid; heat conduction through tubes; and certain points on massecuite working, most of which information has already been disclosed by Dr. CLAASSEN in articles which have been abstracted in the columns of this *Journal* during the past two years. Furthermore, it is to be noticed that at last the author has seen fit to add an index (and a very full one too) to his book, which certainly is one to be read and re-read by all connected with the technical side of sugar manufacture.

Trade Notices.

Buffalo Sugar Machinery. (1) Catalogue No. 6645-E. (2) Catalogue No. 6650-E. (3) Catalogue No. 7900. (The Geo. L. Squier Mfg. Co., Buffalo, N. Y., U.S.A.) 1922. Free on application.

In Catalogues No. 6645-E and 6650-E of the Geo. L. Squier Mfg. Co. are listed numerous apparatus required in the production of cane sugar on the small scale, from a fraction of a ton to one hundred tons in 12 hours. These small plants are very largely sold in Louisiana, in Central and South American countries, India, and elsewhere for use on small estates; and the considerable experience of the firm named in this class of business has enabled it to produce a very wide range of machinery of a most serviceable and robust type. This apparatus is well illustrated and described in the catalogues named, which give clear photographs of the varied equipment, and state measurements and capacities and other useful particulars. Among the items listed may be mentioned small plantation vertical and horizontal mills for animal, steam, and water-wheel power, some with a crusher attached; juice tanks with strainers; open fire defecators; sulphuring apparatus; juice heaters and filters; kettle trains; open evaporators; multiple effect evaporators; pans; centrifugals; boilers and engines; bagasse furnaces; and smaller accessories.

The firm named does not deal exclusively in small capacity plant, and catalogues are available for those requiring larger equipment than are described in these catalogues. Catalogue 7900 is a technical treatise on the cooling and drying of sugar in the "Buffalo Squier" apparatus and is a very well compiled and readable bulletin, which should be in the hands of all concerned with the subject.

Brevities.

In March last, says the *Times*, an important agreement was concluded between the beet-growers and the sugar refiners of Italy, and has already done much to place the sugar industry on a sound basis. There has been a considerable increase in the area under beets and in the yield. The latter rose from an average of 1,790,000 tons for the period 1909–13 to 2,400,000 tons this year. The output of sugar from the refineries increased from an average of 109,000 tons during 1909–13 to 260,000 this year. Sugar imports have fallen.

In a "radio talk" on molasses, Mr. CHAS. W. TAUSSIG, Vice-President of the American Molasses Co., gave a remarkably interesting succinct summary of the uses to which this product may be put,[1] three of the applications mentioned, which are not so generally recognized, being as follows: for road making, the addition of lime forming a compound (calcium saccharate) which is as hard as cement;[2] for use in iron and bronze foundries in moulding sand to make it plastic; and for preserving wood, in place of creosote.

British and American participation in the sugar machinery trade of Java is really much greater than the official figures of imports would suggest, because the Customs returns make no allowance for transshipment cargo, and British, American and German sugar machinery shipped by way of Holland would be credited to the latter country. Vast quantities of machinery are so shipped. In 1920 Java imported 5,320,839 guilders worth of sugar machinery from all sources, and in 1921—17,025,904 guilders worth. In sterling at par these values are equal to £443,403 and £1,418,825 respectively.

During its 1922 crop the Usine Ste. Madeleine, Trinidad, ground 171,896 tons of cane and made 17,880 tons of sugar in the form of greys and washed greys, all of this (except about 6 per cent. which was consumed locally) going to Canadian ports.[3] The average sucrose extraction for the two mills operating in this factory was 93·17 per cent., and the rate of grinding 99·91 tons of cane per hour. The purity of the normal juice was 80·58°, and the recovery of sucrose per cent. sucrose in juice was 90·26, corresponding to a boiler-house efficiency of 99·88 per cent.; while the sucrose recovered in the sugars per cent. sucrose in the cane worked out at 84·09, which figures, as well as those relating to the extraction, are records for this mill.

EARL A. KEELER,[4] writing on *pH* and other electrical measurements, gives an account of a new instrument for recording the turbidity of solutions that may have considerable application in automatic process control. The solution is interposed between a high candle power lamp and a photo-electric cell, which is connected to a 220-volt d.c. circuit, and a recording potentiometer and shunt to measure the current flow through the cell. Variations in the intensity of the light falling on the sensitized plate of the cell affect the number of electrons emitted, and alter the current flow through the cell; so that variations in the turbidity of the liquid under examination result in variations of light transmitted, and in changes of current in the cell circuit.

We are advised that Mr. C. J. H. PENNING and Mr. J. L. CHALONER have opened offices as consulting engineers in London, at Abbey House, 8, Victoria Street, Westminster. Mr. PENNING has had a wide experience in the operation, erection and design of sugar plants for the manufacture of raw and white sugars, including several complete factories, and has had a unique training in Java, Natal and the Philippine Islands. Until recently, he was the resident engineer for the Honolulu Iron Works Co. in Manila, and a director of the Earnshaw Docks and Honolulu Iron Works, in which capacities he was closely connected with the sale and erection of eight complete sugar factories, in the Philippine Islands, from the selection of the sites to the manufacture of the sugar. Two of these plants were of Mr. Penning's own design. Mr. CHALONER is well known as an expert on oil engines, and all technical problems appertaining to the commercial handling and industrial application of all classes of liquid fuel, including alcohol and petrol substitutes and lubricants. Until quite recently he was a technical adviser to the Anglo-Mexican Petroleum Co. (the Royal Dutch-Shell-Pearson group). We understand that these gentlemen will act as independent advisers, consultants, and arbitrators on all matters appertaining to the sugar industry, and also allied industries.

[1] *Facts about Sugar*, 1922, **15**, No. 2, 40 [2] *Ibid.*, 1922, **15**, No. 16, 317.
[3] *Ste Madeleine Review*, 1922, **1**, No. 5, pp. 8, 11, 12. Cf., also *I.S.J.* 1922, 492.
[4] *J. Ind. Eng. Chem.*, 1922, **14**, No. 11, 1011-1012.

Review of Current Technical Literature.[1]

Prevention of Entrainment during Evaporation. *E. Haddon. La Revue Agricole de l'Ile Maurice, 1922, 1, No. 5, 274-275.*

Before the installation of barometric condensers, *ralentisseurs* of the Hodek type no doubt were capable sufficiently of reducing the entrainment of sugar to a fairly low figure; but at the present day when one concentrates under a vacuum of 25 or 26½ in., unless special precautions are taken, the loss may sometimes be very great. In order to ascertain the position, Mr. Haddon fixed a 2 in. pipe into the vapour outlet from the last vessel of his quadruple and connected it with a suitable seal 12 ft. below, the contents of which were examined for sugar from time to time. Between 20 and 90 grms. (and sometimes more) per litre was the amount determined; and assuming that the 4th vessel evaporates 10·2 litres of water per cent. cane while passing from 20 to 28° Bé., it would follow that the loss must be in the neighbourhood of 0·204 to 1·0 per cent. Alarmed at such a figure, he had the idea of installing a "save-all" somewhat similar to that invented by Helmer,[2] but the wire gauze was made into the form of a cone, instead of that of a cylinder. It was then found the day after that the sugar content of the water in the seal was 6 to 15 grms. per litre, a marked improvement. Encouraged by this result, he installed a second cone in a reversed position about 12 in. below the first, and from that time the sugar content of the water in the seal was found to drop to as low a figure as 0 to 3·0 grms. per litre. It was also noticed that the water contained about 0·22 grm. of SO_2, and appreciable traces of SO_3 and iron. As the glucose ratio was double that of the syrups coming from the evaporators, it would seem that sucrose inversion had occurred, presumably as the result of the exposure of the juice in a thin film on the surface of the wire gauze.

Method of denoting Milling Equipment adopted by the Philippine Sugar Chemists' Association. *Anon. Sugar News, 1922, 3, No. 6, 272-273.*

K indicates that knives are included in the installation; the first figure following *K* shows the pitch of the knives; the second figure, the distance of knives from the cane carrier; the horizontal set of figures which follow denote the grooves per inch on the crusher or first mill in order of feed roll, top roll, and discharge roll; the subsequent horizontal row of figures gives the surface grooving on the following mills in same order, and so on through the set. Then the letter *m* following a number indicating the grooving on a certain roll signifies that this roll has juice grooves as well; while the two bottom figures indicate the diam. of the rolls and their length. Thus:

$$\begin{array}{l} K - 2 - 12 \\ 0{\cdot}66 - 0{\cdot}66 \\ 3\,m - 3 - 3 \\ 3\,m - 3 - 3 \\ 3\,m - 3 - 3 \\ 3\,m - 6 - 6\,m \\ 34 \times 78 \end{array}$$

the interpretation of which is that the levelling knives are 2 in. pitch, and are set 12 in. from the carrier; the crusher is a 2-roll with 0·66 in. groove per inch, or 1·5 in. pitch; the first mill has three grooves per inch on all rolls, and juice grooves on feed roll; the second and third mills are grooved the same as the first, all having juice grooves on their feed rolls; the fourth mill has three grooves per inch on feed roll, and six grooves per inch on top and discharge rolls with juice grooves on feed and discharge rolls. Lastly, the mill equipment consists of one set of knives, a 2-roll crusher, a 12-roller mill, 34 in. diam. by 78 in. long.

[2] *I.S.J.*, 1920, 288.

COST OF SUGAR PRODUCTION IN JAMAICA. *Prospectus of the Mortgage Company of Jamaica, Ltd.*, in *West India Committee Circular*, *1922*, *538*.

An interesting light on the cost of production in Jamaica is shown by the cost figures of three estates under the control of the Mortgage Company of Jamaica, Ltd., the total production of which amounts to about one-third the total of the Island:—

	£	s.	d.	£
KEELING-LINDO, LTD. (about 1991 acres under cane):—				
Sugar.—Price realised last year per ton of sugar	15	0	0	
Estimated cost of production	10	14	6	
Net profit per ton	4	5	6	
Profit on 9615 tons at £4 5s. 6d. per ton				41,104
MONYMUSK CENTRAL, LTD. (1266 acres under cane):—				
Sugar.—Price realised last year per ton of sugar	15	12	0	
Estimated cost of production	14	0	0	
Net profit per ton	1	12	0	
Profit on 3878 tons at £1 12s. per ton..				6,204
APPLETON CENTRAL, LTD. (462 acres under cane or available for 1924 replant):—				
Sugar.—Price realised last year per ton of sugar	16	4	0	
Estimated cost of production	13	13	3	
Net profit per ton	2	10	9	
Profit on 1366 tons at £2 10s. 9d. per ton				3,466
Total profit on sugar (excluding that on bananas, etc.) ..				£50,774

STEAM ECONOMY IN THE BEET SUGAR FACTORY USING THE BLOMQUIST SYSTEM. *Anon. Times Trade Supplement*, *1923*, *11*, *332*.

It is reported that in a beet sugar factory in Gothenburg, Germany, steam is being used at a pressure of 711·2 lb. per sq. in. (50 kg. per sq. cm.) on the Blomquist system, which employs as generating units horizontal tubes or cylinders revolving at a high speed. Owing to the centrifugal force, a compact layer of water is formed along the walls of the tubes, and the heat is effectively transferred from them to the water. Experiments with stationary tubes have proved unsuccessful. At the particular factory concerned, the high-pressure plant has a capacity of 6600 lb. of steam an hour. There are six steel tubes, with an external diam. of 12 in., a wall-thickness of 0·413 in., and a length of about 8½ ft., rotating at 330 r.p.m. The thickness of the layer of water on the tube walls varies from about 1·2 in. to 2 in. The steam is used in a de Laval turbine working with an exhaust pressure of 35·5 lb. per sq. in., the exhaust steam being employed for heating purposes. It is stated that pressures up to 100 kg. per sq. cm. (1422 lb. per sq. in.) can be realized with the Blomquist arrangement, which is claimed to be specially suitable for cases where both power and heat are acquired and to render possible a fuel economy of 20 to 25 per cent.

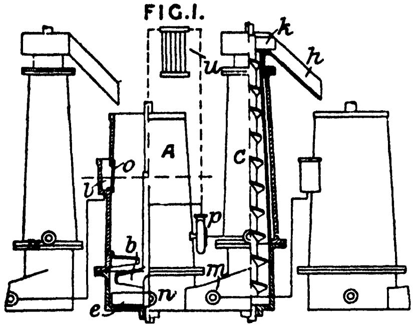
RAK'S PROCESS OF JUICE EXTRACTION FROM THE BEET BY DIFFUSION AND PRESSING. *Alois Rak. Communication from the Inventor, dated December 13th, 1922.*

Rak's apparatus, for which a British patent was recently granted,[1] operates according to the principle of the diffusion battery, but before passing from the diffusion vessel *A* into a subsequent vessel in the battery the slices are submitted to pressure in the press *C*, the following being the advantages claimed: production of waste water is

[1] U.K. Patent, 166, 527; *I.S.J.*, 1921, 705.

eliminated; the spent slices contain a low percentage of water, having been pressed; the juice extracted has a higher concentration and purity than an ordinary diffusion; the water used is about one-tenth that consumed in diffusion; and last (but not least) operation is continuous. One of the most important of these advantages is that relating to the elimination of waste-water. In ordinary diffusion the amount of waste water (including that discharged when emptying the cell, that required for cleaning, and that coming from the slice-presses) amounts to about 200 per cent. of the roots worked, its average density being 0·7° Brix, and its temperature 25° C. Great inconvenience is caused in disposing of this waste-water, owing to the fact that it contains saponins extracted from the beet that are toxic to fish when discharged into a stream,[1] and many have been the processes that have been suggested as means of purifying beet factory waste-water, or of disposing of it in some convenient way. But in the Rak apparatus its formation is entirely obviated, which certainly forms a great argument in favour of such a method of extraction. Another advantage, which has not been mentioned is that in respect of their nitrogen content the slices have a higher feeding value, since in the apparatus the coagulated albumen of the juice is caught by the cossettes, which thus act somewhat as a filter. Then another claim concerns the consumption of power which "in comparison with ordinary diffusion is proportionately very small, there being no machinery required for lifting and pressing the slices, nor is it necessary to lift ten times the quantity of water to a height of 15-20 m. (49-65 ft.)."[2] Yet another claim is that there is a considerable saving in cost of installation and repair expenses, since for normal work only three vessels are required. Two of these apparatus are working in Czecho-Slovakia, and the operation of these may be examined by those interested [3]

FIG. I.



"GINAL" PROCESS FOR THE PURIFICATION OF BEET AND CANE JUICES. *E. Saillard.* *Supplement a la Circulaire hebdomadaire du Syndicat des Fabricants de Sucre de France, No. 1719 of 1922.*

"Ginal" is a preparation containing the sodium salt of alginic acid,[4] and on adding it to a limed juice a precipitate stated to possess a considerable adsorbing power towards the colloidal impurities present in the liquid results. In the early part of this year, its value was tried out in the Nassandres (Eure), France under the supervision of Mr. Saillard, Director of the Laboratory of the Syndicat des Fabricants de Sucre de France, the results being compared with those obtained by the ordinary process of clarification. It was mixed with diffusion juice to a paste; which was added to juice at 75° C. in a tank so that 0·2 kg. were present in each hectolitre. Milk-of-lime (at 22° Bé.) was run in while stirring until the quantity present as CaO was 0·25 kg. per hectolitre, that is about one-tenth the amount used ordinarily in carbonatation. After passing this treated juice through filter-presses and mechanical filters successively, it was limed to about 8 grms. CaO per litre, carbonated at 80° C., filtered, sulphited, after which the usual course of operations was pursued. On the whole the results obtained were not unsatisfactory. It was observed that the purity and saline ratios were about the same as in ordinary carbonatation, as was

[1] See *I.S.J.*, 1921, 171.

[2] One would expect that the power used in the Rak process for the repeated pressings would far more than counterbalance the pumping of the greater amount of water used in ordinary diffusion.—ED., *I.S.J.*

[3] Those desiring further particulars may write to the inventor's agent: Mr. ANT. STANEK, Hostivice u Prahy, Czecho-Slovakia.

[4] *I.S.J.*, 1922, 274, 385.

also the amount of nitrogenous impurities precipitated. On the other hand, the juices clarified by the new process contained more calcium salts; the passage through the presses, though rapid enough at first, gradually became slower, so that 38 minutes were required for the filtration of 85 hectolitres (1870 gall.) whereas 20 minutes sufficed ordinarily. This of course was due to the slimy nature of the precipitate, which could be detached from the cloths only with difficulty, its analysis giving the following figures: Water, 44·15 per cent.; sugar, 1·81; nitrogen, 0·25; phosphoric acid, 0 50; magnesia, 0·67; calcium oxide, 2·36; and carbon dioxide, 19·16. According to the promoters of the "Ginal" process, in the working of 1000 kg. of roots the cost of ordinary carbonatation using 25 kg. of lime at 80 francs per ton is 2·00 francs; whereas by their method, 2 kg. of "Ginal" cost 2 francs, 6 kg. of lime 0·48; overhead, 0·40, a total of 2·88 francs, from which one should deduct 2·07 francs the value of 20 kg. of press cake which as fodder has a value of 56 francs a ton, and also the reduction of the sugar loss, and fuel economy corresponding to 5 kg. of coal at 70 francs per ton, that is, 2·88 — 2·07 = 0·81, as compared with 2 francs for ordinary carbonatation, a saving of 1·19 francs per ton.

FACTOR FOR THE CONVERSION OF THE SULPHATED TO THE CARBONATED ASH OF CANE FACTORY PRODUCTS. *H. A. Cook.* *Facts about Sugar, 1922, 15, No. 21, 418–419.*

BRODIE and REYNOLDS at the H S.P.A. Experiment Station determined the sulphated and carbonated ash of 250 samples of raw sugars, mostly polarizing 96-97°, finding that instead of a factor of 0·9, the average was 0·79, though, as in the case of the results obtained by OGILVIE and LINDFIELD,[1] there was a rather wide variation. Thus 4 per cent. gave a factor below 0·7; 46 per cent. one between 0·70 and 0·75; 98 per cent. between 0 75 and 0·80; 82 per cent. between 0 80 and 0·85; 17 per cent. between 0·85 and 0·90: and only 3 per cent. had a factor over 0·9. It has long been known in the case of raw cane sugars and cane molasses that the factor 0·9, which is generally employed is greatly in error, a fact which has led NOËL DEERR[2] to comment that "the continued use of the 10 per cent. deduction is an instance of the persistence of a once accepted error in spite of numerous protests." Mr. COOK himself obtained with Hawaiian molasses one of 0·734, and in the case of this product it was found to be fairly constant, whereas with raw sugars the contrary was the experience. It is clear therefore that the use of the 0·9 factor now in use is far from accurate when applied to the products of the T.H., and it is suggested that one of 0·75 should now be adopted for molasses. On the other hand, for raw sugars it is not possible to recommend any definite factor, due to the wide variations, and it should be established from the analyses of several samples taken at the particular mill concerned. Other points which emerge from this experimental work are that the loss by volatilization in the method of sample incineration (followed by the addition of ammonium carbonate) is almost negligible; that the results obtained by simple incineration and carbonating check between themselves as well as do those obtained by sulphating; and lastly that for the determination of the ash in sugar factory work, the method of simple incineration followed by carbonating should be adopted.

DETERMINATION OF GUMS IN SUGAR PRODUCTS. *H. T. Ruff and J. R. Withrow.* *Journal of Industrial and Engineering Chemistry, 1922, 14, No. 12, 1131–33.*

Details supplementary to those already given in an abstract[3] are now published. Preliminary experiments showed Bellier's method using calcium chloride and alcohol[4]; Augnet's, using ferric chloride[5]; and Chauvin's, using lead acetate and alcohol,[6] were all unsuitable for application to cane molasses, widely varying results were obtained. Regarding the first, the precipitation requires 24 hours; the second involves two precipitations and two filtrations; while the third includes in the result many other organic non-sugars in addition to the "gums" insoluble in alcohol. For the purpose of control work, the method of precipitating with alcohol in the presence of hydrochloric acid probably gives the most reliable and most constant results, and is recommended by DEERR[7]

[1] *I.S.J.*, 1918, 114. [2] "Cane Sugar," page 525. [3] *I.S.J.*, 1922, 296. [4] *Ann. fals.*, 1910 3, 528. [5] *Ibid.*, 1909, 2, 136. [6] *Mon. sci.*, 1911, 1, 1, 317. [7] "Cane Sugar," page 526.

and by WIECHMANN.[1] However, the acid concentration must be sufficient to decompose the calcium salts of the various organic acids, otherwise the figures obtained are erratic; while in order to obtain consistent comparative results the alcohol concentration should be kept within close limits. According to the procedure recommended by the authors, the sample (freed from suspended matter) is diluted to about 50° Brix, and 10 c.c. or 20 c.c. used for the determination, depending upon the amount of gum present; 0·5 c.c. of hydrochloric acid for the 10 c.c. sample and 1·0 c.c. for the 20 c.c. one is added; and 50 c.c. or 100 c.c. of 93–96 per cent. alcohol (ethyl, methyl, or denatured provided it contains no constituent influencing the precipitation) are run in from a pipette, the mixture being meanwhile agitated. After allowing the liquid to stand for 15 mins., it is passed through a Gooch crucible provided with an asbestos mat, and the residue washed with an alcohol-acid mixture containing more alcohol and less acid than the liquid used for the precipitation. Lastly, the crucible is dried at 100-105° C. for 1 hour, weighed, ignited and re-weighed, a correction being applied in accurate work for the loss in weight of the dried crucible and mat during ignition.

USE OF LIME CONTAINING MAGNESIA (DOLOMITIC LIME) FOR THE CARBONATATION OF BEET JUICE. *Wenzel Kohn.* *Zeitsch. Zuckerind. cechoslov. Republik, 1922, 47, (iv), Nos. 3 and 4, 25-27, 33-38.*

Further details are now given of the experiments on the use of dolomitic lime for the clarification of beet juice by the carbonatation process, a preliminary report on which had already been made[2]; and the net conclusions which emerge from this research are as follows:—As compared with ordinary lime while operating under the same conditions, dolomitic lime gives juices, which are clearer; which are at least as high in purity; and which contain the same or less nitrogen per cent. of the sugar present. Provided the first carbonatation be arrested at an alkalinity of 0·1 per cent. CaO, no magnesia passes into solution; but this immediately happened when the alkalinity is lowered to 0·05 per cent. Further, the amount of carbonatation scums is less than in the ordinary way, the magnesia being present in the form of oxide, from which it is concluded that the amount of CO_2 required must be less, while the duration of gassing must be shorter. Regarding the amount of organic substances precipitated per cent. juice treated, these were found to be 0·52 to 0·70 per cent. when using dolomitic lime, and 0·50 to 0·67 per cent in the ordinary way, which may explain the higher purity given by the magnesia-containing lime. However, it is remarked that practice can only show how juice clarified in this way will behave during evaporation and boiling, whether, for example, any of the difficulties which some people predict actually occur.

RECOVERY OF THE CARBON DIOXIDE FORMED DURING FERMENTATION IN MOLASSES DISTILLERIES. *Henry Arnstein.* *La. Planter, 1922, 69, No. 8, 118-119; 1922, 69, No. 10, 151-152.*

"If we intend to produce, say for example, 10,000 galls. of alcohol daily, and the molasses weighs 12 lbs. per gall., and contains 50 per cent. of total sugar calculated as invert, then if 25,000 galls. of molasses are utilized in the plant daily (i.e., 300,000 lbs.) we have 150,000 lbs. of fermentable sugars, which produce 48·8 per cent. of carbonic acid gas or 73,200 lbs. For practical reasons we may figure that 20 per cent. of this gas will be lost during the process of recovery, and even then the 10,000 galls. of alcohol produced daily will yield simultaneously 58,600 lbs. of gas ready for commercial purposes. Since carbonic acid gas sells to-day between 9 and 10 cents per lb. in New York, it is worth while getting better acquainted with this very valuable by-product." However, the author does not state figures giving the cost of collection and compression (including the large capital outlay on the steel cylinders to contain the liquid CO_2), though he asserts that: "By intelligent and scientific operation of the plant, utilizing all these by-products, the revenue derived therefrom would not only pay for all the operation of the sugar mill and distillery or motor fuel plant, but leave besides a very handsome profit."

[1] "Sugar Analysis," 3rd ed., page 134. [2] *I.S.J.*, 1922, 270.

LABORATORY PURIFICATION AND ANALYSIS OF SODIUM HYDROSULPHITE. *W. O. Christiansen and A. J. Norton.* *Journal of Industrial and Engineering Chemistry*, 1922, 14, No. 12, 1126-1128.

For the purification of sodium hydrosulphite, the outline of the method used (a modification of Jellinek's[1]) was to saturate an aqueous solution of the commercial salt with sodium chloride, there precipitating $Na_2S_2O_4 . 2H_2O$, which subsequently was all hydrated, all these operations being performed *in vacuo* or in an atmosphere of carbon dioxide. Using the commercial material of 85 per cent. purity, it was found possible to obtain in 4½ hours a yield of 42 per cent. of hydrosulphite of 98·3 per cent. purity. For the analysis, the ferricyanide method[2] was found to be superior to either the copper[3] or silver[4] processes.

DESIGN OF INTERNAL COMBUSTION ENGINES FOR ALCOHOL FUEL. *C. W. Petchell.* *La Revue Agricole de l'Ile Maurice*, 1922, 1, No. 4, 200-204.

"Of all the alcohol fuels that I have tried, I have found that 'Natalite' was the most satisfactory substitute for petrol. In the early stages of manufacture we had innumerable complaints. Many were very puerile, such as that the fuel ate away the cylinder walls. I watched the exhaust valves, as I expected to find a certain amount of pitting there, but I never found any trouble. There were also complaints of corrosion of tanks. In the early stages this might have been true in a slight degree, as we had to use wood naphtha as a denaturant. Since the use of Simonsen's oil and pyridine as lenaturants have been allowed these troubles have ceased. . . . . . . At the present time alcohol with different mixtures serves for adaption to the present type of petrol car, and for some time to come will carry us over the transition stage; but in the end I feel sure that alcohol alone, denatured of course to render it undrinkable, will come out on top, as none of the substances added increase its thermal efficiency to any degree equivalent to the extra cost I think that with a suitable carburetter alcohol would give very much better results than any of the mixtures and the present carburetter. The most suitable one would have to break up the alcohol into a spray and be fed with air at a temperature just high enough to vaporize it. The proportions between fuel and air should be nearly constant at all speeds. For the general public a fixed jet should be fitted. Alcohol having such a much wider explosive range than petrol, a big waste of fuel can take place without the driver being aware that his mixture is much too rich. I am frequently told of cars pulling splendidly on 'Natalite' but the consumption is excessive. In almost every case of this sort the carburetter has a variable jet which is too much open. It would be an advantage to have the vaporizer heated up to facilitate starting. This could easily be done by an electric resistance, as is the case, I believe, with some of the paraffin carburetters. It is this difficulty in starting with alcohol alone that has to be overcome, and until there are plentiful supplies of denatured alcohol of good quality to be obtained in every village, sufficient attention will not be paid to overcoming the difficulty."

PREPARATION BY GAS TREATMENT OF ACTIVATED (DECOLORIZING) CARBONS. *F. Fischer, H. Schrader, and K. Zerbe.* *Brennstoff-Chemie*, 1922, 3, No. 16, 241-244.

This paper describes the preparation of activated carbons from different materials for use in the recovery of benzene from washed coke gases. Briefly the method was to heat the carbonaceous substance in an electric oven to 500° C while passing in steam, this latter being later replaced by carbon dioxide or nitrogen and the temperature raised to 800° C. Among the raw materials used were wood (sawdust), leaves, peat, and lignite, and an account is given of the relative efficiency of the several carbons obtained as means for the adsorption of benzene. Cellulose materials treated in an atmosphere of carbon dioxide head the list.

J. P. O.

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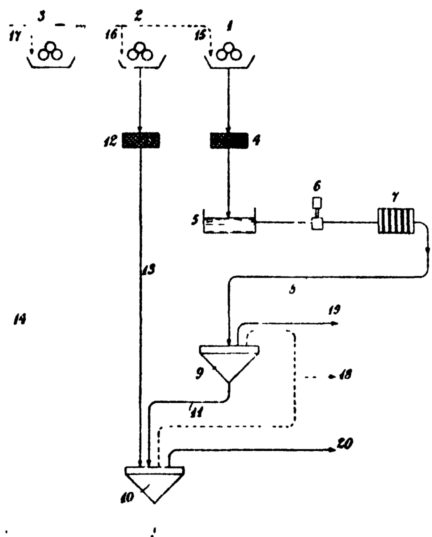
[1] *Z. anorg. Chem.*, 1911, 70, 93. [2] *I.S.J.*, 1921, 108. [3] *Amer. Dyestuff Rep.*, 1920, 7, 12. [4] *J. Amer. Chem. Soc.*, 1921, 43, 1307.

Review of Recent Patents.[1]

UNITED KINGDOM.

PROCESS OF CLARIFYING CANE JUICE. *Cuthbert G. Petree*, of 21, Belsize Crescent, London, N.W. *189,817*. June 3rd, 1921.



According to the present invention, "natural or primary juice" (i.e., juice to which no water has been added) is defecated by chemical and thermal treatment and the defecated juice, together with the mud and scum, is transferred to a settling vessel, the defecated mud therein being transferred to a second settling vessel either before, after, or simultaneously with the removal of the clarified juice from the first settling vessel, to which second settling vessel defecated or "artificial or secondary juice" (i.e., juice to which water has been added) is admitted. The defecated mud in the second settling vessel is allowed to mix or is mixed with the defecated mud resulting from the defecation of the natural or primary juice admitted to the second settling vessel, and the mixture of the two kinds of mud may be applied and distributed over the bagasse, preferably between the first and second crushing mills, or at any other suitable part of the milling circuit. The clarified juice from the first settling vessel and from the second settling vessel may be mixed and delivered through a common pipe to the evaporating plant, or the clarified juice from the two settling vessels may be delivered to the evaporating plant through separate pipes or conduits. Referring to the drawing, *1* is the first crushing mill, *2* the second crushing mill, and *3* the third crushing mill, it being understood, however, that there may be any number of crushing mills arranged consecutively. The natural or primary juice from the mill *1* is screened at *4* and is defecated by chemical and thermal treatment in the tank *5* from which the defecated juice together with the mud and scum is transferred by means of a pump *6* through a heater *7* and a pipe *8*, to a settling vessel *9*. The defecated mud in the settling vessel *9* is transferred to a second settling vessel *10* through a pipe *11* either before, after, or simultaneously with removal of the clarified juice from the first settling vessel *9*. The artificial or secondary juice after screening in the tank *12* and subsequent defecation is delivered through the pipe *13* to the second settling vessel *10*. The defecated mud in the second settling vessel *10* is allowed to mix or is mixed with the defecated mud resulting from the defecation of the natural or primary juice admitted to the second settling vessel *10* and the mixture of the two kinds of mud may be transferred through the pipe *14* and applied or distributed over the bagasse preferably as at *15* between the first and second crushing mills *1* and *2* or as at *16* and *17*, that is to say, between the second and third crushing mills or after the third crushing mill, or the mixture of the two kinds of mud may be applied and distributed over the bagasse at any other suitable part of the milling circuit. The clarified juice from the first settling vessel *9* and from the second settling vessel *10* may be mixed and delivered through a pipe *18* common to both settling vessels *9* and *10* to the evaporating plant or the clarified juice from the settling vessels *9* and *10*

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

may be delivered to the evaporating plant through separate pipes *19*, *20* or conduits as indicated in the drawing. It is to be understood that the chemical treatment above referred to includes liming and heating the natural or primary juice or the artificial or secondary juice or both, as well as sulphitation.

SYSTEM OF VACUUM PAN BOILING, USING AN AUXILIARY TANK. *Thos. C. Jacobs*, of Greenock, N.B. (Communicated in part by *Harry M. Jacobs*, of Felixton, Natal.) 185,707. March 30th, 1922. (No drawings; three claims.)

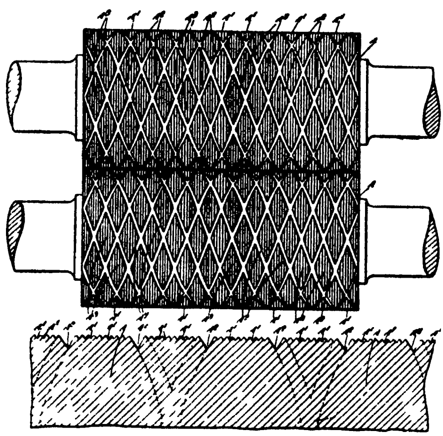
This invention consists of a tank which may be either air tight or open, of any suitable shape and material, and fitted with washout valve and with stirrers or similar contrivance for the keeping the contents in motion. The tank is auxiliary to, and connected with the vacuum pan system, and is to be used for the storage of virgin grain that is to be kept in motion by the stirrers while cooling and thereafter used as a footing for massecuites. When the tank used is air tight, it is erected on the pan floor on any convenient place and level, adjacent to the vacuum pans. It is connected to the vacuum system in a manner similar to that of the vacuum pan connexion, and equipped with the usual accessories for working under reduced pressure. It is also connected to the "cut over" pipe by which the vacuum pans are connected with each other. The connexion thereby made enables the whole or portion of the contents of any vacuum pan in the system being drawn into the tank, or vice versa. When preparing to receive virgin grain for storage and treatment, the tank is exhausted of air and the mass of virgin grain is thereby drawn from the vacuum pan from which the vacuum will be cut off. Similarly, when any grain in the tank is required for a vacuum pan, such grain is drawn into the pan under the pan's vacuum.

As an alternative to the air tight tank, an open one may be used, in which case it must be erected on such lower level that its top will be below the level of the bottom of the vacuum pans. The vacuum pans and the tank will be connected by a pipe of suitable bore, fitted with valves and steam and drain cocks, the pipe being led from the bottom of the vacuum pan to the lowest bottom part of the tank, and an alternative pipe of suitable bore fitted with valves, and led from the bottom of the vacuum pans over into the top and down to the bottom of the tank. The virgin grain is transferred by gravity into the tank through either or both of said pipes where it is stored in motion till required. When any of the said grain is required for a vacuum pan, it can be taken into that pan under the pan's vacuum through either or both of said pipes.

At present, until "virgin grain" is formed, the other vacuum pans have to remain idle, the loss occasioned being about four hours in each cuite cycle. In the system of pan boiling under description, the introduction of a tank as an auxiliary to the vacuum pans enables the users not only to give the grain special treatment, but also to supply the vacuum pans (which otherwise would be idle) with virgin grain after it has been treated and prepared in the tank. In the beginning of each cuite cycle, the tank will have grain prepared and ready to be transferred to any vacuum pan. The vacuum pan first ready will be started to prepare new virgin grain for transfer to the tank, and, while this new grain is being made, the grain in the tank will be transferred as required to the other vacuum pans and used for providing a footing for massecuites in the usual way, during the pan boiling cycle. When the new virgin grain is formed it will be transferred to the tank for treatment there, in preparation for the beginning of the next cuite cycle. The pan in which the new grain was prepared will, after being discharged, be ready to receive a cut from any vacuum pan which has received the prepared grain from the tank and the pan boiling will proceed in the usual way during the pan boiling cycle, for the preparation of massecuites with this proviso that any vacuum pan, which cannot get, when required, a cut from another vacuum pan, may obtain from the tank a cut of grain as footing for massecuite. The tank always having virgin grain on hand for every following cuite cycle, provision is thereby made, not only for the continuous working of all the vacuum pans in the factory simultaneously, but also for the immediate starting of all the vacuum pans after a temporary stoppage, and the using in the vacuum pans of steam which otherwise would be going to waste.

Grooved Mill Rollers. *Henry C. Hinton*, of Funchal, Madeira, and *Charles H. Marsden*, of West Ealing, London. *189,216*. August 24th, 1921.

When mill rollers, in addition to the ordinary shallow circumferential grooves, are provided with deep and wide grooves of rectangular shape for the escape of the juice, the constant employment of scrapers is necessitated, in order to prevent clogging. In order to avoid the use of the scrapers, it has been proposed to make the grooves of V-shape, the sides making an angle between them of about 30°, but it has been found by the inventors that such grooves likewise suffer from the disadvantage of clogging. According to the present invention, however, the rolls of the crushing mill are formed, preferably in addition to the aforesaid narrow shallow circumferential grooves, with relatively wide and deep intersecting right and left-hand helical grooves of V-shape, the sides of which make an angle substantially exceeding the 30° angle mentioned above, so that they will not become clogged with bagasse, the width of these grooves and their pitch or distance apart being such that the total surface area of the diamond-shaped portions into which the surface of the roll is divided by the intersecting helical grooves, considerably exceeds the surface area of the roll that is removed by the formation of these grooves. With a mill, having rolls constructed in accordance with the invention, the cane is thoroughly disintegrated owing to the tearing action of the diamond-shaped portions of the rolls; the helical grooves do not become clogged with bagasse; the necessity for the employment of the scrapers is thus avoided; and the rolls give a very effective grip on the cane.



Turning to the figures, A, A are two rolls ; A^1, A^1 . . . are the usual narrow and shallow circumferential grooves; and A^2, A^2 . . . are the right and left hand helical grooves, which are wider and deeper than the grooves A^1, A^1 . . . (Fig. 2), and which, in the construction shewn, are multiple helices of opposite sense, but may be single helices of opposite sense, in which case they would be of smaller pitch than that of the multiple helices shown. A^8, A^8 . . . . are the diamond-shaped portions into which the surface of each roll is divided by the helical grooves ; and it will be seen that the total surface area of these diamond-shaped portions considerably exceeds the surface area of the portion of the roll that is removed by the formation of the said helical grooves. It is preferred to so mount the rolls in the mill that during their rotation the various points of intersection of the helical grooves of one roll will, in turn, come opposite the centres of the diamond-shaped portions of another roll as we find that the best results are obtained in this manner. As a result of experiments and trials we find that with a roll of 12 in. diam. and 18 in. long. good results are obtained with 6 right and 6 left hand helical grooves each of 12 in. pitch (which gives a difference of 2 in. between the centres of adjacent grooves) and each groove about $\frac{5}{16}$ in. wide at the top and $\frac{1}{4}$ in. deep with an angle of about 60° between the sides. This angle may be somewhat increased and the shape of the grooves in cross section may be slightly varied, but experience shows that the more the said angle is decreased the greater is the liability of the grooves to become clogged. The V-shaped helical grooves may have their sides either straight or slightly curved; the inventors prefer however to have them straight, as shown in the drawing.

CLEANING THE BOWLS OF CENTRIFUGAL MACHINES. *Aktiebolaget Separator,* of Stockholm, Sweden. *181,686; 181,687.* April 13th, 1922; convention date (Germany), June 17th, 1921.

In centrifugal machines used for the separation of slimy matter, the apparatus consists of a receptacle produced with one or more outlet openings for liquid or steam, so arranged that the discharge takes place within the hollow space of the bowl. According to the nature of the layer of slime, different methods may be used. If the quantity of slime is not much compressed, it will be sufficient to use water alone, or a steam jet. If, on the contrary, the slime is so compressed as to form a hard mass, it will be necessary first to fill the receptacle surrounding the slime partly with water, and then by means of steam or air to set the water into a strong whirling movement so as to loose and remove the slime.

EXTRACTION AND CLARIFICATION OF JUICE BY MEANS OF THE COLLOID MILL. *Plauson's (Parent Company), Ltd.,* of London (communicated by *Hermann Plauson,* of Hamburg, Germany). *186,756.* July 30th, 1921.

It has been found by the inventor named that the manufacture of fruit juices, conserves, or other products from fruits, or vegetables, can be better performed if the raw material is transformed into a state of collodial dispersion, it then being possible to precipitate out the undesired constituents selectively, so that the purified solution can be preserved, concentrated, or treated by further suitable processes. By choosing the concentration, the degree of dispersion, and the precipitating agent, it is possible selectively to favour the retention or removal of dried substances. It is remarkable that in this process a kind of maturing appears to take place owing to the high degree of dispersion, which apparently causes chemical reactions such as condensation and esterification between the acids, alcohols, aldehydes and other constituents of the fruit. It follows that the aromas of the juices and other products are characteristic of, if not superior to, those of the products hitherto prepared. In an example given it is stated that, though in the usual mode of juice extraction from the beet the process has been brought to a very high degree of perfection, there is still a loss of about 0·5 per cent. of sugar; but that according to the present invention it is possible to obtain a practically quantitative yield in a very short time by transforming the sections of the beet into the dispersed condition in a colloid mill, and then precipitating the dispersoids which interfere with crystallization (as cellulose and protein) by boiling the liquids, after which the clear juice is treated as usual for separation and saturation.

EVAPORATORS, AND DISTILLING APPARATUS. *Blair, Campbell & McLean, Ltd., and James L. Ferguson,* of Woodville Street, Govan, Glasgow, Scotland. *185,873.* June 23rd, 1921. (Six claims; four figures.)

This invention comprises a heating element, or calandria, a separator connected to the upper end thereof and connected by means of a pipe to the lower end thereof. A heat exchanger is provided with pipes leading from the weak liquor supply tank and to the pipe connecting the separator and the foot of the heating element. A pipe also leads from the separator to the heat exchanger. The weak liquor is conducted from the weak liquor tank to the heat exchanger, wherein its temperature is raised, and then conducted to the foot of the heating element, which is preferably heated by steam. The liquor then rises in the heating element and passes to the separator, wherein the vapours separate from the concentrated or partly concentrated liquor. Part of said vapours escape, and the remainder is withdrawn through an internal pipe and injected into the heating element by a steam injector fan, or pump, so that the vapours are used to heat the weak liquor. The partly concentrated liquor is returned from the separator to the foot of the heating element by means of the pipe already referred to; and, as this pipe is connected to the pipe conducting the weak liquor from the heat exchanger, the weak and partly concentrated liquors are mixed before entering the heating element. When working normally, the liquor in passing through the heating element becomes highly concentrated and is conducted from the separator part to the heat exchanger, where it gives up its

heat to the weak liquor, and then to a concentrated liquor tank, and the remaining part is returned to the foot of the heat exchanger, being mixed with the weak liquor, as aforesaid. The bottom of the separator is preferably of dome, or convex inwards, or of like shape, so as to ensure the quick passage of the liquor from the separator. A funnel is provided at the circumference of the dome, and is connected by a pipe to conduct part of the concentrated liquor to the heat exchanger, as aforesaid. Valves may be provided to regulate or control or shut off the supply of the liquor and steam.

MOULDING REFINED SUGAR. *Soc. des Raffinerie et Sucrerie Say, Soc. Anon., and L. Chambon,* of Paris, France. *186,969.* June 10th, 1921.

Sugar is fed by a pair of intermeshing blades from a hopper into moulds in a table rotated intermittingly by a pin-and-slot gear. Each mould is fitted with a plunger having a stem fitted with a roller engaging stationary cams, of which one is carried by a member adjustable vertically by a screw to regulate the feed. The sugar is compressed against an abutment by toggles operated from a cam, the pressed cakes being ejected above the moulds by a cam-operated lever furnished with a slot adapted to embrace a second roller on each stem.

MULTIPLE EFFECT EVAPORATOR, THE HEATING ELEMENTS OF WHICH ARE ROTATING CYLINDERS. *T. Rigby,* of Victoria Street, Westminster, London. (1) *180,963.* December 24th, 1920. (2) *187,260.* May 10th, 1921. (3) *188,623.* May 10th, 1921. (4) *188,703.* June 16th, 1921.

(1) Liquids are concentrated and dried on the surface of rotating cylinders heated by steam and so arranged in a closed casing as to leave a central open space from which the vapour generated can readily escape so as to be used as a heating medium either on another effect of a multiple effect apparatus, or, after compression, in the cylinders of the original unit. (2) In evaporating liquids in multiple effects apparatus of the kind described in the previous specification, the liquid is passed in series through a number of multiple effect plants, the temperature ranges of which coincide or overlap substantially. In evaporating cane or beet solutions, the concentration obtained in the last plant may be such that crystals separate in the effects of the plant, or cystallization may be effected outside the plant in crystallizing vessels which may be supported on wheeled devices or in heated pans in which slow evaporation takes place. (3) Liquids, or admixture of solids and liquids, to be evaporated by exposure in a film on surfaces heated by vapour generated by film-exposure of another portion in a different part of the apparatus, are preheated by spreading in a film over a surface heated by vapour flashed off from hot liquid leaving a similar drying concentrating or evaporating plant. The preheating may be effected in stages. Specification 180,963 is referred to. (4) Relates to multiple-effect apparatus in which vapour from the final effect, or from one of the final effects, is compressed and used as heating medium in the first effect or one of the first effects. The energy required for the compression is derived from a natural direct source of mechanical energy, such as a fall of water, and heat losses are made up by steam from an electrically heated boiler, the energy for which is derived from the same source. The ordinary steam supply and condensing arrangements are retained in order that the amount of evaporation effected by the steam and by the energy of compression may be varied. Liquid is added to the vapours before or after compression, so as to absorb the superheat and generate make-up vapours. Its application to Specification 187,260 is described.

ALCOHOL MOTOR FUEL. *H. R. Giles,* of New Court, London. *187,326.* July 18th, 1921.

A fuel for internal-combustion engines comprises a mixture of ether, alcohol and a volatile vegetable oil such as rosin oil or oil of turpentine, with or without a small amount of caustic soda. The preferred proportions are 36·75 parts by volume of alcohol, 62 parts of ether, one part of rosin oil, and 0·25 part of a saturated solution of caustic soda in alcohol. "Commercial" ether may be used in slightly larger proportion. This fuel is miscible with lubricating oil and thus is suitable for two-stroke engines.

UNITED STATES.

RECOVERY OF LITHARGE FROM RESIDUES (E.G. THOSE RESULTING FROM THE POLARIZATION OF SUGAR SOLUTIONS). *Alexander S. Ramage* (assignor to *Sugar Research Syndicate, Ltd.*, of Detroit, Mich., U.S.A.) *1,433,034.* October 24th, 1922.

Claim 1:—The method of recovering litharge from sugar residues containing lead carbonate and lead non-sugars, which consists in subjecting the mixture in continuous flow to a gradually increasing controlled temperature, and to a reverse current of air, the oxygen content of which is gradually reduced, the lead content being thus first reduced to metallic lead which is gradually oxidized to litharge.

RECOVERY OF SUCROSE FROM IMPURE SOLUTIONS, USING LEAD HYDROXIDE. *Alexander S. Ramage* (assignor to *International Colour and Chemical Co.*, Inc., Detroit, Mich., U.S.A.). *1,433,654*; *1,433,655.* October 31st, 1922.

Lead hydroxide is added in sufficient excess to precipitate the sucrose with the non-sugar substances; the precipitate is separated, and its sucrose content liberated by "limited carbonatation," thereby forming a solution containing sucrose and a precipitate containing non-sucrose substances. These two are separated, and the lead eliminated from the solution by means of lime; while the precipitate is treated with an alkali hydroxide in excess, thereby dissolving non-sugar material, and converting the bulk of the lead present into hydroxide, which is separated and used again in a succeeding cycle of the process.

PURIFYING SUGAR JUICES BY DECANTATION AND FILTRATION.[1] *Fritz Tiemann*, of Berlin, Wilmersdorf, Germany. *1,430,200.* September 26th, 1922. (Four claims.)

METHOD OF PACKING (REFINED) CUBE SUGAR. *William C. Smend and Walter P. Spreckels*, of Yonkers, N.Y., U.S.A. 1,431,702. October 10th, 1922.

Claim 1:—The method of handling sugar cubes or tablets which consists in causing a layer of of sugar cubes or tablets to adhere by suction to a transporting means, maintaining a partial vacuum through the the transporting means while moving the same to a desired position, the sugar adhering thereto, and then lowering the vacuum by the inflow of air through the sugar into the transporting means, whereby the sugar is released.

BEET HARVESTERS. (1) *Merrell S. Montague*, of Twin Falls, Idaho, U.S.A. *1,434,834.* November 7th, 1922. (2) *Walter Hoagg*, of Detroit, Mich., U.S.A. *1,436,501.* November 21st, 1922. (3) *William R. Howard*, of Estherville, Iowa, U.S.A. *1,436,502.* November 21st, 1922.

BEET TOPPERS. *John Scholl and Richard Parlow*, of Belgium, Wis, U.S.A. *1,432,912*; *1,432,913.* October 24th, 1922.

BEET WASHER. *E. A Franklin and G. J. Daley.* 1,430,896. October 3rd, 1922.

BEET CLEANING SCREEN. *A. G. J. Rapp.* 1,431,684. October 10th, 1922.

BEET DUMP. *J. A. Lynch.* 1,432,195. October 17th, 1922.

BEET CONVEYOR. *J. L. Wentz.* 1,432,002. October 17th, 1922.

CANE (AND KAFFIR CORN) TOPPER. *A. H. Harris.* 1,431,950. October 17th, 1922.

LUBRICATING MOUNTING FOR CENTRIFUGAL MACHINES. *W. Bartholomew.* 1,432,095. October 17th, 1922.

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[1] See *I.S.J.*, 1922, 51.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to January 11th, 1923.)

	Harvesting Period.	1922-23. Tons.	1921-22. Tons.	1920-21. Tons.
United States—Louisiana	Oct.-Jan.	215,000	289,669	150,996
Texas	,, ,,	2,875	2,920	6,238
Porto Rico	Jan.-June	350,000	362,442	438,494
Hawaiian Islands	Nov.-July	476,000	490,000	508,392
West Indies—Virgin Islands	Jan.-June	6,000	5,000	4,500
Cuba	Dec.-June	4,000,000	3,996,387	3,936,040
British West Indies—Trinidad	Jan -June	55,000	59,948	54,933
Barbados	,, ,,	35,000	36,000	24,817
Jamaica	,, ,,	38,000	42,167	39,960
Antigua	Feb.-July	12,000	9,850	11,320
St. Kitts	Feb.-Aug.	15,000	8,426	8,063
Other British West Indies	Jan.-June	10,000	9,238	3,603
French West Indies—Martinique	Jan.-July	19,700	18,329	23,834
Guadeloupe	,, ,,	30,000	32,000	25,426
San Domingo	Jan.-June	200,000	225,000	185,546
Haiti	Dec.-June	12,000	12,283	5,625
Mexico	,, ,,	120,000	119,800	115,000
Central America—Guatemala	Jan.-June	20,000	19,090	17,500
Other Central America	,, ,,	28,000	27,972	36,692
South America—				
Demerara	Oct.-Dec. and May-June	100,000	107,797	96,168
Surinam	Oct.-Jan.	11,000	10,000	9,394
Venezuela	Oct.-June	16,000	16,000	22,806
Ecuador	Oct.-Feb.	8,000	7,000	6,998
Peru	Jan.-Dec.	340,000	325,000	344,024
Argentina	May-Nov.	200,000	175,000	202,158
Brazil	Oct.-Feb.	425,000	491,933	340,063
Total in America		6,744,575	6,899,251	6,618,590
Asia—Brit. India (consumed locally)	Dec.-May	2,575,000	2,500,000	2,506,320
Java (1923-24, 1,720,000)	May-Nov.	1,750,000	1,649,610	1,508,755
Formosa and Japan	Nov.-June	405,800	406,966	342,176
Philippine Islands	,, ,,	285,000	338,160	255,843
Total in Asia		5,015,800	4,894,736	4,613,094
Australia	June-Nov.	300,000	298,701	182,401
Fiji Islands	,, ,,	52,000	65,000	73,000
Total in Australia and Polynesia		352,000	363,701	255,401
Africa—Egypt	Jan.-June	90,000	100,000	79,706
Mauritius	Aug.-Jan.	225,000	182,234	259,872
Réunion	,, ,,	40,000	38,593	42,079
Natal (1923-24, 200,000)	May-Oct.	157,521	146,983	155,194
Mozambique	,, ,,	45,000	35,000	51,009
Total in Africa		557,521	502,810	587,860
Europe—Spain	Dec.-June	6,000	5,000	6,886
Total cane sugar crops		12,675,896	12,665,498	12,081,831
Europe—Beet sugar crops		4,730,500	4,055,043	3,681,461
United States—Beet sugar crop	July-Jan.	625,000	911,190	969,419
Canada—Beet sugar crop	Oct.-Dec.	15,000	18,931	34,600
Total beet sugar crops		5,370,500	4,985,164	4,685,480
Grand total Cane and Beet Sugar	**Tons**	**18,046,396**	**17,650,662**	**16,767,311**
Estimated increase in the world's production	,,	395,734	883,351	1,566,910

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922. Tons.
Total Receipts, January 1st to January 24th..	159,074	..	202,103
Deliveries ,, ,, ...	159,074	..	202,103
Meltings by Refiners ,, ,, ...	121,870	..	170,000
Exports of Refined ,, ,, ...	3,000	..	24,000
Importers' Stocks, January 24th..	—	..	—
Total Stocks, January 24th	55,038	..	63,545
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1919-1920, 1920-1921, AND 1921-1922.

(Tons of 2,240 lbs.)	1919 20 Tons.		1920 21 Tons		1921 22 Tons.
Exports	3,363,773	..	2,585,727	..	3,866,886
Stocks	192,471	..	889,781		8,478
	3,556,244		3,475,508		3,875,364
Invisible Supplies	53,833	..	330,532	.	—
Local Consumption	120,000		130,000		121,023
Total Production..	3,730,077		3,936,040		3,996,387

Havana, December 29th, 1922. J. GUMA. L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to January 11th, 1923.)

	Harvesting Period.	1922-23. Tons.	1921-22. Tons.	1920-21. Tons.
Germany	Sept.-Jan...	1,600,000	1,305,810	1,152,960
Czecho-Slovakia	Sept.-Jan...	750,000	659,907	705,919
Hungary and Austria	Sept.-Jan...	94,500	91,220	47,644
France	Sept.-Jan...	560,000	278,273	305,041
Belgium	Sept.-Jan...	295,000	289,866	242,589
Holland	Sept.-Jan...	285,000	376,000	317,196
Russia (Ukraine, Poland, etc.)	Sept.-Jan...	220,000	49,374	88,490
Poland	Sept.-Jan...	270,000	225,000	189,834
Sweden	Sept.-Jan. .	63,000	227,000	164,194
Denmark	Sept.-Jan...	105,000	146,800	134,835
Italy	Sept.-Jan...	260,000	217,532	135,484
Spain	Sept.-Jan...	170,000	135,000	170,722
Switzerland	Sept.-Jan...	8,000	5,500	3,710
Bulgaria	Sept.-Jan...	25,000	22,000	7,837
Rumania	Sept.-Jan...	25,000	25,761	15,006
Total in Europe		4,730,500	4,055,043	3,681,461

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Notes and Comments.

The Sugar Market: a Shortage Scare.

Not since 1920 has there been such a speculative element in the sugar market as began on the 13th of last month in New York and was reflected in an advance in sugar quotations in the United Kingdom. According to American advices, the main cause of what was almost a panic was the publication by the U.S. Department of Commerce of a report on the sugar situation that was taken by the American press and trade generally as an indication of a shortage of the world's sugar supplies of about three-quarters of a million tons. The position was aggravated by the fact that the general press which summarized this Report omitted part of the figures, which part showed in effect that instead of a shortage there would be a carry-over next autumn of 476,000 tons.[1] Moreover, the Report itself omitted to allow for the additional supplies forthcoming at the end of the year through the 1923-24 domestic beet crop and the Louisiana cane crop beginning in October next. The American trade strongly blame their Government for butting in with what they describe as "the usual Government report of partial information." Unfortunately, the scare was given further substance by the chance publication at that precise moment of an adverse estimate of the Cuban crop by Messrs. GUMA-MEJER, who reduced their previous figures of 4,193,500 tons to 3,800,000 tons.

The result was that one Tuesday afternoon the price of Cuban sugar c.i.f. New York rose 100 points on the New York market (from round 4¼ cents to 5¼ cents or the equivalent of about 26s. 9d. c.i.f. United Kingdom). By Thursday it had fallen about the same amount once more, but the following week there was a steady advance in prices to over 5 cents, and at the time of writing a series of fluctuations has left the price at about 5¼ cents. During this speculative movement Cubas for the United Kingdom have been quoted some days as high as 27s. 9d., but have been secured on others as low as 20s. 6d.

This has been largely a speculator's business, as the refiners have held aloof and only bought moderate amounts. The opinion is expressed that when these speculative purchases are thrown on the market later on, they will have to contend

[1] These figures will be found on p. 151.

with the wonderful output from Cuba's present crop; the shortage of stocks at January 1st last is being wiped out by the augmentation of the Cuban supplies; moreover, the recent rise in the price of sugar will tend to check consumption, and if it is at all maintained during the summer a considerable carry-over must be looked for next January. It should be added that the bullish effect of the Guma-Mejer estimate has since been partly counteracted by the refusal of Mr. HIMELY to reduce his own figures, which stand at 4,102,857 tons.

But the moral of the whole—for the United Kingdom consumer at any rate—is the danger of a Cuban monopoly of sugar supplies. It is not good that we should be so dependent on that island for so large a proportion of our sugar imports, since it makes us peculiarly susceptible to fluctuations in price as a consequence of real or alleged shortages in the Cuban crop. On another page the matter is discussed at greater length, and emphasis is made that the only remedy is for the United Kingdom to arrange to produce a larger proportion of its sugar requirements within the Colonial Office colonies.

The American 1922 Sugar Consumption.

Another view on the American consumption of sugar in 1922 is given in the *New York Journal of Commerce*, by Mr. FRANK C. LOWRY, of E. Atkins & Company. Some critics, as we showed last month, hold that it was distribution rather than consumption that disposed of over five million odd tons last year in the States. But Mr. LOWRY only considers the misleading statement is to talk of 24 per cent. increase over the 1921 consumption, because 1922 was the first normal year in sugar since the outbreak of the Great War in 1914. During all the intervening period the consumption of sugar was restricted either by Government regulations or by relatively high prices and irregular distribution. The average increase over a period of 100 years has been 5·40 per cent. per annum. But taking the 1913 consumption as a basis and compounding a yearly increased consumption of 5·40 per cent., the United States consumption in 1922 should have been even bigger than the actual amount of 5,092,758 long tons. This, in Mr. Lowry's view, is the more important basis of comparison. As for 1923 he opines that if general conditions in the States remain reasonably prosperous, and the price of sugar does not get too high, the distribution this year will not be very different from last year's. There is undoubtedly a larger invisible supply in the country than a year ago but he does not consider there is anything unusual in this reserve stock; it was last year's supplies that were abnormally low.

Production versus Consumption in 1923.

As for the outlook during the coming year, Mr. LOWRY considers the main uncertainty lies in the extent to which the world as a whole may develop its sugar consumption. To quote him in extenso: "People like sugar, because it is a convenient luxury and the extent of its use is generally closely linked with the ability to purchase. Had there been no war and the consumption of sugar increased at its normal rate, the world would to-day be eating some 4,000,000 tons more than the world will this year produce. Who then can safely say how much sugar at current values the world will desire to use under existing conditions? There is the gamble. Inasmuch as sugar is produced the world over, and unfavourable conditions here or there affect only this or that crop, we can, with reasonable certainty estimate the world's production at 18,046,396 tons this year against 17,650,662 tons last year, compared with 18,436,478 tons in 1913. The weight of supplies is very evenly distributed in that no one country appears to have any

excess. Locally this is particularly true as last year on January 1st Cuba carried over 1,200,000 tons, and we then had at least 200,000 tons more domestic beet sugar, so that our visible stocks this year are at least 1,400,000 tons less. All of which tends to make the market quite buoyant and if, as we go along, there should be any unfavourable developments in producing centres that will cut down supplies, and consumption holds up as anticipated, the market conceivably might have quite a rise before it was checked, particularly as developments in the last few years have attracted a good deal of trading of a speculative nature, which naturally has its influence.

"As Cuba is the largest sugar producing country in the world, developments there are watched closely. While the statisticians have estimated that this year's outturn will exceed last year's record crop by from 106,668 to 197,300 tons, these figures are not generally accepted in the island where many well posted people can be found who believe that the crop will be less than last year. They base their claim on the fact that some districts will be short because the cane has suffered from dry weather and that generally there will be, as compared with last year, a reduction in yields which will not be made up by an increased tonnage of cane. It is true that last season the weather was exceptionally fine and yields were correspondingly very high. So far, the weather has been too warm and yields have not been good. Recently there has been some improvement and we hope this will continue. What will actually happen is anybody's guess.

"There is one point that must not be lost sight of, which the "Bulls" do not always take pains to point out, namely, that the sugar year is not the calendar year but runs from September to September, and high prices in the spring months have in the past almost certainly brought about increased sowings of sugar beets both here and abroad. Inasmuch as this is a crop, harvesting of which begins the following September, to-day's probable supplies may be augmented in the fall by such an increase, whatever it may prove to be. However, no one in the trade wishes to see prices skyrocketing. A good average price is in the end much more satisfactory to both producers and distributors. It would seem that 1923 should be a year in which producers should get a reasonable price for their product and benefit accordingly."

The British Empire Exhibition, 1924.

The British Empire Exhibition to be held next year at Wembley Park, a north-west suburb of London, is being planned on an unprecedented scale. The last big exhibition held in this country, the Franco-British one in 1908, covered an area of 144 acres at the White City; the Wembley Park exhibition will comprise 216 acres. The ground to be covered by the new buildings will amount as at present planned to 2,100,000 sq. ft., as compared with a total floor space at the Franco-British display of about 874,000 acres. The "Great" Exhibition of 1851 in Hyde Park covered no more than 26 acres of ground.

Naturally, the Dominions and Colonies are taking an active part; they are building and equipping their own sections. Amongst other features, a West Indian garden is planned which will contain growing plants in tubs, to be placed out of doors when the weather is favourable enough. Jamaica is expected to provide this. Coffee, cocoa, coconut, sugar cane, tobacco, cotton, yam, banana, pineapple, and other tropical plants are amongst those considered suitable for this garden. Some of these plants will be sent to England this summer to be acclimatized for six months at Kew, while others will only be sent in 1924 in time for the Exhibition. That food products, including sugar and confectionery, will be strongly represented goes without saying. Details of this section will be forthcoming later.

A first list of intending exhibitors in the general engineering section has just been published,[1] but we regret to find that so far none of the makers of what is generally called "sugar machinery" have applied for space, with the exception of Messrs. Watson, Laidlaw & Co., Ltd., of Glasgow; and this firm, as is known, confines its specialities to one department of the sugar factory. It is sincerely to be hoped that the leading makers of milling and evaporating plant in England and Scotland will be represented at this Exhibition, which promises to be the largest and most epoch-making ever held in this country, if not in the world. Amongst makers of accessories to the sugar factory well known through our advertising pages, several as a matter of fact have already booked space, including Sir William H. Bailey & Co., Ltd., Messrs. Drysdale & Co., Ltd., and Messrs. G. & J. Weir, Ltd., but those who specialize in sugar machinery proper have still apparently to make application. The British Engineers' Association, of 32, Victoria Street, London, S.W.1., are the organizers of the General Engineering Section, and to them all communications on this subject should be addressed. The Machinery Hall will be under their superintendence and will be of immense size. It is intended to provide ample facilities for showing the mechanical exhibits in motion and some interesting and striking novelties in mechanical engineering practice and development will be demonstrated in this way.

British Empire Sugar Research Association.

The Report for the year 1922 of the Directing Committee of the British Empire Sugar Research Association states that the Council, having considered very fully the position of the Association, came to the conclusion at the end of 1921 that in the then state of the sugar industry it was unwise to attempt to increase substantially either the number of members or the amount paid by the existing members. In these circumstances it was evident that the scheme by which the Association was to receive an annual grant of £2500 on condition that its subscriptions reached a similar amount must be postponed, and that scientific work must be started on a more modest scale than had been originally intended. Negotiations were accordingly opened with the Department of Scientific and Industrial Research, as a result of which an arrangement was come to by which the Department made a grant of £600 towards the employment of a research chemist on condition that a similar amount should be contributed by the Association. It is satisfactory to record, says the Report, that through the augmenting of existing subscriptions this amount is now forthcoming.

One condition of the agreement drawn up with the Department was that the affairs of the Association should be administered by a small Directing Committee, and this Committee was accordingly appointed to consist of Sir EDWARD DAVSON (Chairman of Council), Mr. RUTHERFORD, alternative, Mr. W. SCOTT HERRIOT, Mr. A. D. JACKSON, Mr. W. MARTINEAU, and Mr. HAROLD T. POOLEY (Hon. Secretary). The thanks of the Association are due to Professor BRERETON BAKER, of the Imperial College, and Sir FRANCIS WATTS, K.C.M.G., of the West Indian Agricultural College; Professor BAKER, who has helped the Association with constant advice on technical subjects and has given the great benefit of his experience at its meetings; and Sir FRANCIS WATTS for taking part in the discussions with the Research Department and consenting to act in regard to the scientific direction of the research during the sojourn of the research chemist in the West Indies.

The Directing Committee at the start applied itself to the task of appointing a suitable research chemist, and it was unanimously decided, after consultation

[1] Seventy per cent. of the space in this Section is already allotted.

with leading scientific authorities, to appoint Mr. R. G. FARNELL, A.R.C.S., A.I.C. This gentleman spent the greater part of his first year in England, going at the start to study at Glasgow Technical College, and after that returning to London, where he made a study of the methods of dealing with gums, pectins, and other colloidal substances. On the conclusion of this work, he proceeded to the West Indies, reaching British Guiana at the beginning of last November; there he was to spend two months during the grinding season in order to make himself familiar with the general routine of sugar plantations, after which he was to proceed to Trinidad and work under the scientific direction of Sir FRANCIS WATTS at the West Indian Agricultural College. After Mr. FARNELL has been in the West Indies for six months, it will be decided whether he shall extend his visit there or proceed to other sugar-producing parts of the Empire.

The United Kingdom Sugar Supply.

The Cuban Menace.

The phenomenal rise in the price of sugar in New York which took place on the 13th of February last illustrates in a very marked manner the dominating position which the Cuban sugar crop occupies in relation to the world's sugar production, and consequently to the world's price of sugar. During the fortnight preceding the day in question, probably on the principle of coming events casting their shadows before, there had been a steady rise in values, amounting, in the case of Cuban sugars to £4 per ton. On the 13th of February, Guma-Mejer's revised estimate of the Cuban crop, in which the first estimate of 4,192,000 tons was reduced to 3,800,000 tons, became public, and the price of Cuban sugar at once went up a further £5, making a total increase in the fifteen days of £9 per ton, equal to 60 per cent. on the preceding f.o.b. price. Although the £5 increase was not maintained at the time, the quotation had risen by the 20th to within a few shillings of this amount, and the fact that it occurred in the manner it did, shows the unsatisfactory position in which consumers throughout the world are by reason of the concentration of so much of the world's sugar—at present the Cuban crop is above 22 per cent. of the whole—in one country, the situation being further aggravated by the preferential relations as regards sugar which exist between the United States and Cuba, the practical effect of which is that only the surplus of the Cuban crop above the United States wants is available for general purposes. A comparatively small decrease in the Cuban crop thus becomes magnified as regards other countries drawing upon Cuban sugar.

The United Kingdom consumer is particularly prejudicially affected by Cuban crop variations as, in the absence of supplies of sugar from elsewhere, he has to depend largely upon Cuban sugar. Last year, in the form of raw sugar for our refiners and refined sugar from the United States and Canada made from Cuban sugar, half of our sugar imports emanated from Cuba. Our own colonies only supplied a little over 15 per cent., and the balance had to be made up of about 7 per cent. from the Continent, 8½ per cent. from Java, 5 per cent. from Peru, 6 per cent. from Brazil, and small quantities from other countries. With the exception of Java, which has its own customers in the East to serve, no country is in a position to supply the United Kingdom with much sugar, although the 15 per cent. of Empire sugar might have been 25 per cent. had it not been for more advantageous markets elsewhere. A shortage on the Cuban crop is therefore an especially serious matter to the United Kingdom consumer.

In the present position of the sugar producing world, there is, unfortunately little prospect of supplies coming forward which would free the United Kingdom from Cuba's dangerous dominance as regards sugar. Continental production shows no sign of materially increasing exporting power, in fact, last year's imports from this source were considerably less than in 1921, and the economic position in what were the large exporting countries of the Continent is not such as to encourage great expectations from those sources. Java has evidently reached her limit of production, and although Peru and Brazil are increasing their exports, those countries are not likely to become important factors in the world's supply, at any rate for a considerable number of years. Australia and South Africa have their own consumers to think of, and India is a long way short of an exporting position, even if the economic conditions ever became favourable to an exporting industry, while it is evident that in existing circumstances our colonies under the ægis of the Colonial Office are not likely to increase their contribution by any material amount. The Formosa production is earmarked for Japan, that of the Philippines for the United States.

It is true that under a degree of protection of phenomenal height endeavours are being made to establish a beet industry in this country. It is, however, still in its productive infancy, and there remains yet unsettled the question of policy connected with it: whether it would interfere or not with the production of other agricultural products, of which already there is an insufficient supply. In its present position the most sanguine supporter of the home grown beet sugar industry cannot regard it as being a way out of the Cuban difficulty.

What, therefore, would appear to be clearly indicated as to the course which should be pursued to secure the stabilization of the United Kingdom sugar supply, and to protect the consumer from the constant recurrence of price storms due to Cuban sugar, is for this country to take measures which would increase its supply of sugar from the Colonial Office colonies. As already mentioned 25 per cent. of last year's imports might have been from these sources, instead of 15 per cent. and if the whole of the present available supply of this sugar were secured to the country, with a further development to the extent of an additional 30 or 40 per cent., the position would be safeguarded. But to effect this, to attract the whole of the existing available Empire sugar, and to bring into existence more, it is necessary that there should be sufficient inducement provided, a tariff treatment of colonial sugar which would not only be adequate in amount but also in duration.

The preference which colonial sugars now receive in the United Kingdom tariff is a rebate of one-sixth of the duty. At the present duty the value of this is £4 5s. 0d. for white, £3 15s. 0d. per ton for 96° sugar. There is also a "pledge" on the part of the Government that the rule of preference—not the amount of it—shall continue for ten years. That the amount is not sufficient is shown by the fact that a little more than half of the available Empire sugar came here last year, while the "pledge" does not guarantee the continuance of the present preference value.

In 1920 the world's sugar markets were upset by Cuba, now in 1923 there are symptoms of more trouble from the same source. In the interest of the United Kingdom sugar consumers, it is very evident that something should be done by the Government to free them from the constant Cuban menace, and it is equally evident that this would be best effected by measures being taken to secure "in perpetuity" a supply of Empire sugar which would form a substantial guarantee against the Cuban control of the United Kingdom sugar market.

F. I. S.

Fifty Years Ago.

From the "Sugar Cane," March, 1873.

In an editorial in this issue of our predecessor, the question of the limit of the consumption of sugar was discussed. Gradually the *per capita* consumption of the United Kingdom had been rising, quite rapidly during the previous two decades, and had then reached what was considered to be the limit, namely about 51 lbs., or almost a pound of sugar a week for each inhabitant of this country. This was regarded as "really enormous," and the writer made the following comments on the record which had been attained. "No amount of prosperity can fairly be expected to raise the consumption to a higher point than will be reached in a family of the middle classes, where (owing to the low duties and prices, and also to the general prosperity of the industrial classes) sugar is freely used without stint . . . . . . In such a family of eight, including children (no infants), adults, and domestic servants, the consumption of sugar for last year was sixty-seven pounds per head . . . . . From these figures we cannot fairly expect to see the amount of sugar used for human food at any time to surpass the present rate by twenty pounds per head . . . . ." This prediction, however, has not proved correct, since in the year 1912-13 the average *per capita* consumption of sugar in the United Kingdom for all classes was over 90 lbs.

Then in this number there appeared an article reproduced from the *American Grocer*, on "The Sandwich Islands, the Future Sugar Country of the United States in the Pacific," extracts from which are now of some little interest. After emphasizing the desirability of the independence of the United States of all other commonwealths in the matter of certain food supplies, including sugar, the writer remarked that "Cuba, the most important country to us, as the source from which we draw the bulk of our sugar supply, we may eventually become the owners of . . . . . . But the continued dependence upon Cuba for sugar may be to some extent circumvented, either by our acquiring St. Domingo . . . . . . or we may become the owners of the Sandwich Islands and convert them into a second Barbados, covered with sugar plantations . . . . . . Their possession would give us a sugar-producing country of the first-class, right off . . . . . . In a couple of years we should produce as much sugar in the ten islands as Jamaica has done in her palmiest days, and our Pacific States would be altogether independent of Java and Manila for all time to come, so far as our main staple of imports were concerned . . . . . . That the Sandwich Islands will eventually become American, little doubt can be entertained . . . . . ."

Mr. ALFRED FRYER, the Editor of the *Sugar Cane*, continued his series of contributions "On the influence of Forests on Rainfall," and recounted various examples of the denudation of forest being followed by a diminution of rain, or a lowering in the water level of lakes in the neigbourhood, and concluded that the destruction of forest is the true cause of such diminution of rain, strengthening his position by giving instances of lakes, situated in localities where there had been no forest clearing, which had not shown any falling off in their waters.

Lastly, Dr. GRÆGER gave an account of a method of preparing a "strongly decolorizing animal charcoal," which consisted in extracting char first with a solution of sodium carbonate, and then with one of hydrochloric acid, a yield of 20 per cent. of carbon, having highly decolorizing properties, being stated to have been obtained in this way.

The German Sugar Industry in its Present State.

(From a German Correspondent.)

The German sugar industry is making steady, but very slow headway towards recovery of its pre-war position. During 1922 considerable quantities of sugar had to be imported. A certain shortage in the supply could be observed through the whole year. The export kept within narrow limits.

The reason for this slow progress is doubtless the control of sugar, which is still being continued long after all the other chief agricultural products have been liberated. Under conditions prevailing at the end of the year an acre of sugar beet yielded 210,000 marks as against 700,000 marks for an acre of corn, or less than one-third. The inducement to growers is lacking, and the gentle but persistent coercion, now exercised, produces insufficient results. Furthermore, the distribution, which, lying in the hands of the Government, is handled with a good deal of red tape routine, causes considerable delay in the reimbursement of the growers. At the end of the last year, for instance, when the campaign was nearly finished, the growers had received only part payment for the roots delivered from the factories, which themselves are entirely dependent in this respect upon the usually slow rate at which they receive payment from the State. In view of the general strained state of finances, the beet growers are thus placed in a far from enviable position. Hence the universal clamour for decontrol, which at this season is breaking out again with renewed vigour.

The results of last campaign from 1st September up to the end of the year 1922 were 988,312 tons of raw sugar and 545,711 tons of marketable products, as against 1,003,400 tons and 505,182 tons respectively in the corresponding period of 1921. Substituting for the marketable products the value in raw sugar at the ratio of 9 : 10, the total of raw sugar production in the campaign up to the end of December was 1,594,657 tons in 1922 as against 1,564,724 tons in the preceding year. The actual progress made in comparison to 1921 in the sugar supply is, however, somewhat larger than would appear from these figures, as the quantity consumed in the factories and refineries for refining purposes has in the last campaign been considerably less than in 1921. After deducting these quantities, a total remains, which in raw sugar value is 1,303,990 metric tons, compared with 1,225,772 tons in 1921. The following figures show the production in metric tons of marketable sugar already mentioned, classified in grades :—

	1st September to 31st December. 1922.	1921.
Crystal sugar	281,654	230,012
Grain	51,435	68,107
Candy	2,821	4,204
Loaf	3,651	6,251
Cubes and bars	21,985	22,495
Lump	850	3,165
Ground refined	77,902	62,987
Ground loaf	89,383	89,882
Powdered	12,339	16,303
Purified molasses, including invert sugar syrup.	2,691	1,786

The figures given for the output between 1st September and 31st December, 1922, represent in the main the result of the whole campaign. The quantity of roots still in the process of slicing by the end of the year was small. From a circular report of all sugar-producing factories the grand total of the 1922-23 campaign is estimated as follows :—

	1922-23. Metric tons.		1921-22. Metric tons.
Beetroots supplied	9,388,735	..	7,548,370
Output of sugar (raw sugar value)	1,482,970	..	1,296,621
Molasses	20,000	..	19,938

The area of sugar beet cultivation was in 1922 about 8 per cent. larger than in the preceding year, but was still considerably smaller than the pre-war average, even after deducting therefrom the alienated territories. The respective figures are the following:—

Area of Beet Culture	Acres.
1922-23	901,208
1913-14 (present German territory)	1,081,094
1913-14 (pre-war ,, ,,)	1,321,450

It is thus seen that Germany has, through the war, lost 240,000 acres or 17 per cent. of beet growing territory, while in another considerable part, amounting to 169,000 acres, beet growing has not yet been resumed. Last year's supply of roots to the factories and the output of sugar compared with pre-war times can be seen from the following figures:—

	1922-23. Metric tons.		1913-14 (present German territory). Metric tons.		1913-14 (pre war German territory). Metric tons.
Supply of beets..	9,388,735	..	13,755,335	..	16,939,979
Total output of sugar (raw sugar value).	1,482,970	..	2,240,698	..	2,715,870

Taking into consideration Germany's present territory only, the deficit against the last pre-war year amounts to 31·7 per cent. of the supply of roots and 33·8 per cent. in the output of sugar. A drop is also visible in the beet production per acre and in the amount of raw sugar obtained per ton of roots. The former was in 1913-14 12·7 tons per acre and in 1922-23 10·4 tons, the latter 163 kg. and 158 kg. respectively. The crop in both years was of a good average.

The output of sugar in 1922-23 is estimated to be barely sufficient for the country's own requirements. Last year's import amounted to 169,000 tons and the export to 12,500 tons, a rather large drop from the proud position Germany used to occupy in the world's sugar supply. The excess of import over export was 156,500 tons, which will in the current year be made up partly by the increase of output. A deficit remains of some 30,000 tons, which has to be covered by import. The chief countries of origin of the latter are the U.S. of America, the Dutch Indies, and Czecho-Slovakia. The export went almost entirely to the Sarre district and other former territories of Germany.

We regret to have to record the death at the age of 64 of Mr. D. Y. Cassels, senior partner in the well-known firm of Pott, Cassels & Williamson, engineers and ironfounders, of Motherwell, which firm he helped to start thirty years ago. The deceased gentleman had a very wide connexion in business circles in Scotland, especially in the Iron and Steel trade. His early training was obtained in the works of the Glasgow Iron & Steel Co. Ltd., whose large establishment in Motherwell he managed for some years prior to the founding of the firm of Pott, Cassels & Williamson. He was for many years a Director of the Steel Co. of Scotland Ltd., and also sat on the Board of several other important concerns in the West of Scotland. In private life Mr. Cassels was a distinguished figure in athletics, particularly in Rugby football, in which game he played for Scotland for several years, and latterly rose to be President of the Scottish Football Union Committee.

The Dominican sugar crop which started late this season is expected to be about 200,000 tons or the same as last year. Drought, fires and lack of re-planting have caused a shortage in places, but this will be offset by the production of a new estate which is reaping its first crop. Prices are encouraging, being at the close of 1922 about 3½ cents per lb. c.i.f., as compared with 2¼ cents average a year ago.

Experimental Work in the Hawaiian Islands.

In our last issue[1] we discussed the Economics of Hawaiian Sugar Estates, as developed in the Annual Report of the Director of Experimental Stations, and now proceed to deal with some of the results of the year's plantation work in the biological and chemical sections.

INSECT AND OTHER PESTS.

The Cane borer.—This continues to be satisfactorily controlled by the Tachinid introduced in 1910. SWEZEY reports that "Wherever any borer injury has been examined, the presence of the parasites was noted, and usually it was found that a good percentage of the borers had been destroyed by them."

The Leafhopper.—There was no serious outbreak during the year, and the main line of work was the spread of the new natural enemy, *Cyrtorhinus mundulus*, introduced in 1920 from Australia. SWEZEY reports that the egg parasites Ootetrastichus and Paranagrus are apparently effective, the relative infection by the former being 10-50 per cent., and by the latter 20-65 per cent., while both taken together account for an infection of 60-75 per cent. The recently introduced bug, Cyrtorhinus, has increased remarkably wherever leafhopper is present as food. It attacks both parasitized and non-parasitized eggs, and its possible effects on the two egg parasites by cutting off their food supply has been carefully considered, although it has not had this effect in either Fiji or Australia. A hypothetical case is presented in which the attack of Cyrtorhinus and Paranagrus reaches 80 per cent. in each case. The effect of Paranagrus alone would be that, out of 100 eggs laid by the leafhopper, 20 of the latter would emerge as against 80 of the parasite. If, on the other hand, both Cyrtorhinus and Paranagrus were present, only 4 leafhoppers and 16 Paranagrus would survive.

White grub (chiefly Anomala but also Adoretus). In 1915 a Scoliid wasp was introduced from the Philippines, with the result that the damage done by Anomala is now practically negligible, and many thousands of the Scoliid wasps have been spared for New Jersey, where a white grub has become very troublesome in recent years. During the year the Scoliid has been observed as abundant where Adoretus alone was present, hence it is concluded that the parasite will probably have some effect on this beetle also. For some unknown reason the Scoliid does not appear to thrive on the Island of Hawaii.

Wireworms.—Newly planted fields of D 1135 appear to be subject to severe damage by wireworms, and trials of poison baits and repellants do not appear to be successful in reducing their numbers. Less damage is sustained by Yellow Caledonia, Badila, and the Yellow Tip canes, so that a replacement of D 1135 by these is suggested where possible; where not feasible more seed cane must be planted to obtain a full stand. Meantime travelling entomologists, after thoroughly investigating Australia and the Philippines, have turned to Central America for parasites of the wireworms and at present Ecuador is being investigated.

Aphids and Mealy bugs, although minor pests, probably take their toll in the harvest. A ladybird, *Micronurus vinaceus*, has been introduced from Australia, which feeds on these and is widely distributed, and now two more, Diomis and Nephus, have arrived from Mexico. In Mexico they attack the grey mealy bug, but here they are found feeding on the pink. These are considered valuable additions to the insect enemies of plant lice in the Hawaiian canefields.

Army and Cut worms have been unusually prevalent during the spring in mountain plantations in Hawaii, especially on *mauka* fields (recently put under

[1] *I.S.J.*, 1923, page 63.

cultivation), near the grass lands where they breed. The cut worms attack the seed cane and cause a serious set back in the fields. Two Tachinid and two Ichneumon flies have been introduced, but they do not appear to act as efficient controls, probably because of successive invasions from the grass lands. Thus more parasites and insect eating birds are required, and a general search is being made in Mexico for the natural enemies of these pests. Meantime, poisoned bran may be usefully employed, and it has been found that bagasse may be substituted for the bran.

Rat invasions.—These are serious pests in the canefields, besides introducing and spreading plague among the labourers. Dealing with this highly intelligent class of animals is a very difficult problem, but interesting results have during the year been obtained at the Honokaa plantation, where intensive methods have led to very promising results. PEMBERTON, working in co-operation with the staff on the estates, reports as follows:—Trapping has proved unsatisfactory. During 1915-18, 268,761 rats were caught and destroyed at a cost of $40,672, and yet there was no decrease in the number of rat-eaten canes. In 1919-20 double this quantity were caught, and during this time as well there was no appreciable result. In Honokaa the destruction caused by the pests was estimated by the estate officers at $100,000 a year, and this figure has been checked and found approximately correct by PEMBERTON. Of 39,200 canes examined, 29 per cent. had been attacked, with a 50 per cent. loss in purity, besides the large numbers of canes which had died. The rats appear to establish themselves in the fields as soon as the leaves cover the ground and cultivation ceases, and they remain there until the harvest, when they migrate to adjoining fields or shelter in waste places or rocky ground.

Various poisons were accordingly tried and, as the result of experiment, two stand out as likely to be of economic value, barium carbonate and strychnine. PEMBERTON believes that the employment of these has led to an almost complete eradication of the rats from the estate. The barium was prepared in cakes of wheat flour and 7½ millions of these cakes were distributed in the canefields, about 10 ft. apart, over 10,368 acres, besides several thousand acres of waste land adjoining. The strychnine was made into a paste with flour, wheat grain was coated with this paste at the rate of 1 oz. to 25 lbs., and 7000 lbs. of poisoned grain were distributed during February and March. The latter poison was found to be specially deadly to mice which, although not injuring the cane, are plague disseminators. The cost of these applications was remarkably small, being 26 cents per acre for both and 16 cents for the barium alone. Rats have practically disappeared from the fields, and the estimates for the current year include the necessary expenditure to treat the whole of the company's plantations. (For a full discussion of rats in cane fields and their eradication, see *I.S.J.*, 1922, pages 525, 578 and 624).

CANE DISEASES.

The chief diseases of general interest which are treated of in the Report are mosaic and root rot.

Mosaic.—Important progress is claimed with regard to our knowledge of this disease of the sugar cane, owing to the labours of LYON and KUNKEL. Mosaic disease has been found to attack various wild and cultivated grasses, and there is some reason for assuming that the disease on these is the same as that attacking the sugar cane. It is stated that there is strong evidence that it will pass from sugar cane to both maize and sorghum. Only a single insect transmitter of the cane mosaic has been discovered in Hawaii, the corn aphis (*Aphis maidis*), which,

however, does not appear to feed upon the cane by preference. KUNKEL claims to have transferred mosaic from diseased to healthy canes by juice injection. A series of experiments has been made to determine the loss caused by planting sets which are diseased, and the results are summarized in tables, which leave no doubt that none of the standard varieties of cane can carry mosaic without heavy loss in sugar production. In the laboratory KUNKEL has proved the presence of intracellular organisms similar to those which he has found in mosaic in other plants and which he there considered to be causative organisms. These are found in the youngest portions of the canes, and are not perceptible in older tissues owing to the necrotic condition of the cells, which would account for their escaping the notice of other observers. He also observed that, when the outer covering leaves in infected shoots were removed, the newly forming leaves within regained their uniform deep green colour, from which he gathers that the causatic organisms are destroyed by light, thus explaining the cases observed where plants appear to recover normality after showing signs of attack. Following up this line of investigation, experiments are being conducted with X-rays during the present season.

Root rot (formerly called *Lahaina disease* and elsewhere *Root disease*).—Continued research on this disease from all points of view appears, in Hawaii, to be crystallizing the belief that it represents an unhealthy condition of the plant, manifested by a depletion of the root system; and it is suggested that, when the circumstances are fully understood, it will be found to be generally due to a combined attack of animal and vegetable parasites, no doubt intimately connected with climatic and soil conditions and the kind of cane planted, all depending on whether the cane has sufficient vitality to keep on putting forth fresh roots to replace those that have been destroyed. During the year, KUNKEL has observed that the rootlets of the diseased canes are covered by minute holes or abrasions, and has carefully studied the soil fauna to discover which form might be the cause of this. PEMBERTON has practically proved that in certain localities the punctures are caused by a minute, thread-like, and very active centipede, *Mecistocephalus maxillaris*, which, although of course usually carnivorous, is quite capable of inflicting the injury. Meanwhile CARPENTER, in bringing his mycological studies to a close, reports that he is confirmed in his belief that Pythium is the main factor as regards fungi in destroying the roots. STEWART has carefully analysed the soil in the affected fields and found no chemical fault for the poor growth of ratoons, and his observations support the general opinion regarding the effect of climatic conditions and varietal resistance. He found that the root rot trouble was prevalent in the cooler fields on the windy side of Kauai, and especially evident during the period of lowest temperature, which continued longer than usual during the past winter. Preliminary observations indicate that the vitality of Yellow Caledonia was insufficient to cope with those conditions; fields upon the warm leeward side of Kauai showed vigorous growth, and no difficulty whatever was found in growing healthy ratoons of this variety. This furnishes further evidence that root rot "is favoured by damp, unfavourable growing conditions, and disappears with warmth and light."

REAFFORESTATION WORK.

It will not be out of place here briefly to refer to an interesting development, in this section of the sugar planters' experimental work, which is mainly due to the work of their entomologist. In reviewing last year's report,[1] a reference was

[1] *I.S.J.*, 1922, page 69.

made to the desirability of increasing the number of fig trees in the forest areas as from their hardy nature and spreading habit these are a most desirable addition to the areas where the forest is gradually disappearing. But the fig trees in Hawaii do not produce fertile seed, and this was traced to the absence of the wasps which are necessary for the ripening of the figs. As a result of the introduction of the appropriate wasp in 1921, however, a good crop of fertile fruit was obtained on two large trees of the Moreton Bay fig tree in Honolulu. During the year under review another wasp (*Pleistodontes imperialis*), which is associated with the Port Jackson fig tree, also growing and fruitless in the island, was introduced by PEMBERTON in January, 1922. In July of the same year ripening figs were observed on the tree, and these were found to contain living specimens of the newly introduced wasp. The prospects of fertile seed of this second useful fig tree are, therefore, distinctly promising.

One of the main difficulties in seed distribution of forest trees over areas requiring replenishing is the great amount of manual labour required in placing the seed at the right time in the habitat most suited to it, and this is especially the case with the fig trees whose seeds are in nature distributed by birds on the forks of the branches of trees, on decaying stumps and so on. During the year an interesting experiment has been tried, through the co-operation of the Army Department, of rehabilitating the moribund forests in the islands by sowing seed from an aeroplane. It is considered that this innovation will, in a comparatively brief period, perform the work which would otherwise take generations to accomplish. The dropping of the fig seeds from above is also of peculiarly appropriateness, considering the natural mode of growth of this tree, and it appears to have been successfully accomplished with Moreton Bay fig seed over an area where numerous dying forest trees offered exactly the right natural conditions.

SOIL STUDIES.

The chemical study of soils on Hawaiian sugar plantations continues to be prosecuted with vigour, and it is claimed that analyses of these show the advantage of developing our knowledge of the manurial requirements in a one-crop system of agriculture. Some of the results are apparently not altogether in accord with those obtained in other countries, and would therefore emphasize the danger of generalizing from the results obtained in any one locality. In parts of India, for instance, it is recognized that continued irrigation, especially with saline water, besides completely changing the physical character of the soil, has a strong tendency to develop alkaline conditions. The results of analyses in Hawaii are reassuring on this point. "A study of the soils on the Ewa plantation, which have been subjected to saline irrigation and heavy applications of nitrate of soda for a number of years, when compared with soils which have not been so treated, showed that no great changes had taken place owing to this treatment. This work was conducted on three soils of radically different types, one a red coral soil, the second a brown silty clay loam, and the third a heavy black clay adobe." These results were obtained by repeated analyses of soils taken from the upper and lower parts of different estates, while the original condition of the land was gauged by taking samples from the banks and borders of the fields, where irrigating water and fertilizer salts had probably not percolated, and comparing them with those under long-continued treatment. Further work in the fields at Ewa by STEWART tended to confirm the results of his lysimeter experiments, showing that nitrates are largely retained in the second and third foot of soil, so that no great loss occurs under ordinary conditions of cropping.

Phosphates.—Intensive studies as to the rôle played by phosphatic manures have been continued, and special attention has been paid to comparisons between fields which have shown a response to phosphatic manuring and those with both doubtful results and none at all. In cases of no response, the determination of the total phosphoric acid by fusion, or that available to the plant judged by the 1 per cent. citric acid method, has uniformly given a higher value in phosphatic content in the soil. The extent, in the soils examined, of the citric acid soluble phosphates was found to vary between 0·0009 and 0·319 per cent. Response was obtained in fields containing from 0·0009 to 0·0027 per cent., none in fields with 0·0026 to 0·319. Further, the acidity of responding soils varied from 4·6 to 6·3, and of non-responding from 6·1 to 8·2 ; lime was found to be in a more soluble condition in soils giving no response, and this was also the case with silica. From these results the conclusion is drawn that "a knowledge of the acidity, lime content, and citric acid soluble silica will add greatly to the interpretation of the analyses."

On one plantation interesting determinations of the phosphoric acid in the juices of the cane were made from part of the fields harvested, and analyses were made of the soil in some of the same fields. By both methods conclusions were drawn as to the available phosphate in the soil, and there was an excellent agreement between them in cases where the amount was considered high. The agreement was also traceable but less complete in fields with intermediate or low quantities of available phosphate and further observations are called for in these.

C. A. B.

The Australian Sugar Industry.

Progress facilitated by the Late War.

By T. D. CHATAWAY.

The Australian general elections are over, and it is certain that the demand of the cane sugar producers that the agreement, which yet has a few months to run, should be renewed, has been rejected. Had the Labour party succeeded it would have given a new agreement, but this would doubtless have been loaded with conditions, such as those contained in its political programme, providing for the workers in the industry to have a voice in its management. Before parliament rose last October the Government, having evidently made up its mind that to promise a renewal of the agreement meant disaster at the then forthcoming elections, introduced an amendment of the tariff giving a duty of £9 6s. 8d. a ton on raw sugar and £14 on white—not necessarily refined whites but the mill whites which seem quite sufficient for the manufacturers of jams, and which are the serious competitors from coloured and cheap labour countries with the raw sugars, not washed or refined, produced in Queensland and New South Wales. Parliament approved of the first duty item, but eliminated the second, the Country and Labour parties joining votes to defeat what they vaguely imagined was protection for the refiners rather than for the producers. In the subsequent elections Queensland alone demanded a renewal of the agreement, and the sugar industry ceased to interest the other portions of Australia, even the fruit-growing districts.

THE JAM MANUFACTURERS.

The accusation that the high price of sugar had reduced jam makers' profits to the vanishing point, and that consequently they could not pay increased prices for green fruit, and indeed could not take all the fruit offering, has been exploded

in the simplest manner. The Henry Jones Company, the biggest jam manufacturers in Australia, with branches in South Africa and America, recently declared a dividend of 10 per cent. out of its Australian profits, with 2½ per cent. out of those earned abroad. The report made the significant remark that despite hard times the 10 per cent. dividend out of Australian profits had been paid regularly since 1917. Another Victorian jam-making concern—the Rosella—has just declared a dividend of 12½ per cent., as compared with 8 per cent. in the previous year. Other companies show no indication that they are on the verge of ruin, but there is a good deal of proof that the growers have pushed on with fruit-growing—not necessarily of jam fruits—to the verge of recklessness, with no attention to the markets, and no consideration of the prospects of remunerative selling either in Australia or abroad. But this is a passing phase. Already the growers are awakening to the fact that what they have been told is expensive sugar has no bearing upon the fact that they have over-supplied the visible fruit market. Parliament approves of a rebate of duty on all sugar contained in jam, milk, confectionery and biscuits exported. To ask that a rebate be given on the sugar in similar products produced for home consumption is of course to re-open the whole fiscal issue, and to invite the retort from the sugar producers and consumers that all duties should be taken off imported jams, milk, confectionery, etc., to the possible destruction of already established manufactures. It is perhaps also significant of the artificiality of the outcry about the high price of sugar that the lady President of the Housewives' Association, an experienced platform speaker and a clever political controversialist, offered herself for election in Victoria on the dear sugar scandal, and amidst a multiplicity of candidates only secured fourth place, with one member required.

Persistent Political Faith.

There is one other political point which has been driven home by the elections in the sugar districts, and then this side of the industry can be dismissed, so long as the politicians will allow it to be. When the big plantations were broken up voluntarily and central co-operative mills established—a principle which received the warm endorsement of the Norman Royal Commission to the West Indies in 1895—large numbers of ploughmen and other Europeans took up small farms. They were to prove the backbone of the industry, though, as I had occasion to point out some three years ago, they were also an element of weakness in the matter of economic development. We are now finding them liable to be a matter of political weakness. There has arisen amongst them a class of agitator who seeks to retain them on the side of the unsound political economics of the Labour party. They are taught to believe that the mill-owner robs them, because the refiner robs, so they are told, the mill-owner. They are instructed in the art of industrial civil war, rather than in that of co-operation. During the late election the agitators came out in their true colours. In the name of the white sugar cane growers they came South and violently attacked the Federal Government, and at the same time preached their pernicious doctrine amongst the fruit-growers and others in the South. They were warmly seconded by the Premier of Queensland, who declared that if the Federal Government would not protect the cane-growers from the depredations of the refiners he was prepared to commandeer the industry and attend to the matter. Of course this way madness lies. Happily the small cane-growers were not easily misled. The work of the Australian Sugar Producers' Association had been too sound, and the recent three years' agreement for which the Commonwealth was responsible had placed them upon the best footing within

their experience. Still the danger remains. It does not come from organized Labour but from possibly well-meaning men who have been used as agents for the Socialists. When mere manual labourers they imbibed the Socialistic faith, and now they have become small landed proprietors they still hanker after some form of government control, which they fondly believe will protect them from the depredations of others. And this despite the fact that all the sugar mills under State control pay less for their cane than do the co-operative or privately-owned mills. The matter calls for mention as it is a factor to be reckoned with in all attempts to substitute many small holders for a few large ones. In the present case the cane-farmers by their rejection of the sugar policy emanating from Labour and its henchmen showed themselves wise to the intrigues, and sensible of where their true interests lay.

EFFECTS OF THE AGREEMENT.

Though seasonal conditions may hide the fact, there is no question that the sugar industry has been greatly benefited by the agreement.[1] Before it was made there was coming about an actual reduction in the area planted with cane, the mills were not being improved, and there were many directions in which possible economies were ignored. Sugar was soaring in the world's markets and Labour Governments in Australia were forcing the sale of sugar down to a price which involved loss. The industry was stagnant, and well-nigh hopeless. The effect to Australia was shown soon after when, had there been no local supplies, the consumer would have paid up to 1s. 6d. and more a lb. for sugar. The first result of the agreement was to make the industry peaceful industrially and profitable financially. It is the industrial peace which may be expected as one of the after effects, even when the agreement has ceased to operate. It has been found possible to carry on for three years without serious trouble, though of course there have been frequent discussions over points in dispute. The mere fact that the market will not be a fixed one, and that there may have to be readjustments from time to time, does not prevent the policy which has been successful persisting. Another remarkable effect has been the fact that the various mills, believing in the future, and having profits to spend, have in some cases been moved to more suitable localities, and in others been very considerably increased as to capacity. It seems almost incredible that a Royal Commission, inquiring on behalf of the State Labour Government as to districts requiring new sugar mills, should find itself, in the Mackay district, faced with the evidence of the local people that no new mills are required. It is not often that we find the temptation to "touch" the Government for the matter of half a million so promptly rejected. Except in certain new districts in the North there is ample milling power, not in many and small mills but in factories ranging from 7000 to 15,000 tons capacity per season. That is a benefit conferred by the agreement, and one which cannot die with its expiry.

POWER ALCOHOL IN THE CANE FIELDS.

About three years ago the question of utilizing the millions of gallons of molasses then going to waste for the production of power alcohol was discussed with some of the leaders of the sugar industry, and a director of one of the largest mills put the matter to me in a nutshell:—"We know we should distil the molasses; our noses have been kept to the grindstone, but when we have the money we shall do it." Those who have read some of my previous papers in

[1] At the beginning of 1920 the Commonwealth Government brought together the refiners, mill-owners, cane-growers and representatives of the Labour unions, and secured a three years' agreement based upon the Government paying £30 6s. 8d. a ton for raw sugar, the refiners a fixed charge for refining and distribution, and the unions agreeing not to strike for higher wages.

the *International Sugar Journal* will doubtless recall the fact that I have mentioned this matter nearly every time. At last we seem to be nearing accomplishment. The sugar agreement enabled the mills to be enlarged, the cane areas extended and the credit of the industry established. Incidentally the Commonwealth Government, having an idle acetone plant near Brisbane, proceeded to get molasses from Cairns and convert it into motor alcohol. I am informed, though I have not verified the statement, that at the present moment the motor vehicles of the Postal Department in Melbourne are being run chiefly on alcohol made from Queensland molasses. But the more decisive movement is announced from the Mackay district. A company is being formed, in which four mills are interested, to erect a distillery for the manufacture of power alcohol. The capital is to be £500,000, half of which is being subscribed. Molasses which is now destroyed, often at considerable expense, will be treated at the distillery, and the price paid for it should add about 5s. to the value of every ton of 96 per cent. sugar. From the molasses alone, to be drawn under contract from the four mills, it is anticipated that in the second year the production will be 2,000,000 gallons of power alcohol. The total of gallons of liquid fuel used in Queensland about five years ago was eighteen millions, but in the sugar districts it was an infinitesimal quantity. On the calculations of the above-mentioned company the Mackay district alone, if the other mills also joined this or a separate combination, would produce at least 6,000,000 gallons a year. But the first figure is sufficient for illustration. Mackay district could be made self-contained in the matter of fuel alcohol. The expenses in capital, labour and material of horse traction in the field would disappear. Already it is being found that a well-paid white man will, with a tractor plough, do at least three times the work of a white man at about £4 a week, with horse traction. Obviously there is no "spelling" the team at the headlands, nor the delay of feeding and watering the horses during the day. The tractor driver is the sole unit calling for rest and food, and if he is paid per acre he can manage with wondrously little. In the past the cost of fuel for internal combustion engines has been the greatest drawback. Now the farmer, supplied either by tank trucks on the tramways, or by truck carts, themselves motor-driven, from the centres of distillation, will get his fuel at the lowest possible rate which will pay the distiller. The latter cannot overcharge, for his very investment depends upon the supply of molasses, and these last upon the profitable production by the growers of sugar cane. I anticipate within the next three years that the horse will be practically eliminated. Forty years ago it was all hand-labour by coloured gangs, with a few expert coloured men driving ploughs, and spoiling the horses. The next stage has been the disappearance of the coloured man and the employment of well-paid white men in the fields, and of increased horse implements. We are now on the edge of employing no horses, but tractor implements, doing several times the work and enabling the white man to be paid still higher wages.

Shipping Costs.

The decision of the country to force the sugar industry to rely upon the protection afforded by the import duties may also have beneficial effect in regard to the reduction in the cost of handling raw sugars at the ports, and in bringing it down to the refineries. For many years there have been employed some forms of cheap conveyors and stackers, but the work has never been established on the best modern methods. The Port of Cairns, which now handles large quantities of sugar, both from its own hinterland and neighbouring districts, is about to instal an up-to-date plant at the waterside. The matter has been discussed for

some time, but recent advices indicate that the talk is about to be followed by action at a very early date. It is expected that several shillings per ton of sugar will be saved. Recently in parliament the statement was made by a Minister that the cost of handling sugar by sea had been reduced from £2 to £1 17s. 6d. a ton. This is of course irrespective of the Cairns savings which have not yet commenced. The sugar mill's profit in the past has frequently fallen to a very few shillings per ton, and even now may probably be said to average 35s. to 40s. Obviously if only 5s. is abolished in the matter of costs, the profits of the sugar mills will be increased by a very appreciable amount. But as increase in cost rises apparently out of proportion to the first added cost, so a decrease in expenses also saves more money than at first sight might be expected. But concerning the shipping costs there is much yet to be accomplished, and it is well within view without troubling greatly about the actual rates of wages paid to the men employed on the steamers.

ITALIAN IMMIGRATION.

A considerable number of Italians have lately arrived in Australia and most of them have made their way into the sugar districts. They are not helped in any way by official Australia, but appear to have come out entirely on their own initiative. The Italian cane-growers in the Herbert district commenced their first settlement away back in the early eighties, and they have maintained and extended their holdings. An Italian having proved himself a good worker the community offers to place him on a farm on terms. When he has paid off his debts he becomes one of the community to help place other Italians on the land. These men have done well both for themselves and for the country, and in many cases it must now be the second generation which is occupying the farms. Amongst the nomad cane-cutting population there is of course a good deal of grumbling against the "foreigners" who are seizing the industry, but when appealed to to take land themselves the nomads mostly retort that they do not intend to work all the year round when they can earn ample wages cane-cutting for a few months in the year. During the election campaign there were not wanting those, especially in the South, who objected to the protection or assistance of the cane sugar industry on the grounds that it was largely dominated by foreigners. That this is a misapprehension is easily seen by the electoral rolls, a mere glance at which shows that names of British origin largely predominate. Strength has lately been lent to the agitation against Italians through the foolish action of some of these immigrants. They arrived in Australia by a new steamer service direct from the Mediterranean, landed at the ports for which they were not destined just as the prolonged Christmas holidays had commenced. Naturally they found themselves in difficulties. Amongst them were 50 bound for North Queensland who landed themselves in Melbourne. Others on arrival in Sydney were met by an agitating countryman who urged them to return to Europe as quickly as possible. The Commonwealth Government, however, does not permit foreigners to land indiscriminately in Australia, but limits the number to relatively the proportion of the previous year. Australia is well aware that she must pay for her "white" tropics, and those who begrudge this are disposed to assert that the white man cannot live and work in the tropics, and if he can then he must come from the Mediterranean littoral. So far the statement has proved very wide of the mark. It might be added that amongst the foreigners in the tropics next to the Italians the most numerous are the Scandinavians, who assuredly cannot be said to have come from a semi-tropical climate.

The Cause of the Caking of Raw Sugars.[1]

By W. F. V. H. DUKER.

Complaints have been made by the Californian and Hawaiian Sugar Refining Corporation regarding the physical qualities of some of the raw sugars shipped from the territory to the mainland, the defects mentioned being deterioration, sweating, stickiness, small grain and conglomerates, and caking. Regarding deterioration and sweating, in only very few cases do complaints arise; and the same remark applies to stickiness, which may be traced to the quality of the cane, to faulty clarification, or more often to poorly boiled strikes. As to small grain and conglomerates, the causes of these defects are now well known, and can be eliminated when sufficient pan capacity is available, and when a good circulation is maintained in the pans during the period of boiling.

In respect of caking, however, our knowledge is not very definite, and the opinion of managers, chemists, and others on the question has been elicited, and is here summarized.

Mr. H. D. Beveridge (Onomea Sugar Co.) said that he believed the trouble to be due at least partly to gums or waxes from unripe cane or tops causing the crystals to cement together, as without any change in the process of manufacture the defect in question sometimes disappears. Latterly, he has been liming more heavily, boiling the first massecuite at a lower temperature, washing all first sugars lightly in the centrifugals with cold water, using a larger bagging bin with spreader and Sturtevant blower, and lastly giving the sugar more time to cool off before bagging. According to his experience, it is large-grained, molasses-coated sugars that mostly harden if bagged hot and sent to the pile directly. The cooler the sugar, the less chance of its hardening.

Mr. Herbert Walker (Pioneer Mill Co., Ltd.) wrote that he supected that abnormal weather conditions may have something to do with the defect under discussion, since early in 1920 it was experienced in his factory, but disappeared without any change in methods, and has not recurred again. His theory of the actual cause is the formation of a supersaturated syrup film around the crystal at a certain temperature, crystallization settling in later when the temperature has fallen, causing surfaces of contiguous grains to cement together. If the sugar be kept in motion while cooling, there can be no caking, but if bagged and piled hot the individual grains are joined together after the fashion of a "false conglomerate." This theory does not contradict the belief that weather conditions play a part in affecting the phenomenon, since if a bag of sugar stored at 70°F. (21°C.) has its molasses film saturated, some sucrose will pass into solution when the temperature goes up to 100°F. (37·8°C.), and some will crystallize out when the temperature falls again, causing the grains to stick together. Humidity changes may accomplish the same result, since under the influence of damp air the sugar would absorb moisture, causing some crystal to pass into solution; while, if later the atmosphere becomes very dry, water evaporates from the molasses film, which on becoming supersaturated is subject to crystallization, the result again being the cementing of the separate crystals. According to this theory, the less molasses contained in a sugar, and the smaller its grain, the more susceptible is it to caking. Prevention lies in getting the sugars as dry and as cool as possible before bagging and storing. A revolving disc at the top of the bin, provided it is also equipped with arrangements for supplying a current of fresh air, has a good cooling effect; and the idea of a blower to blow the sugar from elevator to bin appears promising.

[1] Abridgment of a report presented to the Committee on the Manufacture of Sugar and Utilization of By-Products, appointed by the Hawaiian Sugar Planters' Association, 1922.

H. N. CRITES (Pepeekeo Sugar Co.) was somewhat at a loss to suggest a reason. Whereas in his factory formerly a certain amount caked, recently not one bag in ten thousand has hardened, conditions apparently being the same. However, he believes that a sugar having a moisture content of 0·7 per cent., provided it has been sufficiently washed, and rotated in a dryer till cool, will not suffer from the defect; and that on the contrary one which has not been washed, and has a film of high purity molasses, and is bagged hot, will later give trouble in this respect.

F. T. CONANT (Honomu Sugar Co.) remarked that as it has always been stated that the cause of caking was bagging hot, his factory concluded that the only remedy was to build a large bin and ensure cooling before bagging. However, to be absolutely sure that cooling was the remedy he cooled about 6 tons to 37°C. (99°F.) before bagging, but to his amazement found the product caked worse than that which had been bagged hot. Assuming that the high concentration of the molasses surrounding the crystal to be the cause, he increased the amount of water used for washing the sugar, and applied it when most of the molasses has been driven off. Under these conditions the moisture in the sugar was unchanged, but a much freer sugar was obtained, and since this method has been in vogue no complaints (other than those relating to lots which have been stored near the boiler of the steamer) have been heard from the refinery.

Mr. WM. LOUGHER (Hawaiian Commercial and Sugar Co.) mentioned that the method of cooling he employs is to pass the sugar through a Hersey dryer, of course without steam. The moisture content of the sugars of his factory averaged 0·773 per cent. during 1922, whereas during the past three years it was over 1 per cent. Undoubtedly a lower moisture content would enhance the keeping qualities, making it less liable to caking, provided it could be shipped immediately, in place of being in storage for several months in the factory warehouse, where it must be absorbing much moisture. Such sugar, subjected to an atmosphere containing considerably less moisture than it does itself, is bound to become more or less caked.

Regarding the opinions expressed above, it may be remarked by the author that he has taken the temperatures at different factories of the freshly bagged sugar, and found it to be as high as 112-120°F. (44-49°C.) in places from which no complaints of caking had ever been received. The general impression seems to be that an alkaline sugar cakes less; but that when sugars are bagged hot and immediately piled and left undisturbed for some time during dry weather the chances of trouble due to caking are greatest. Mr. H. C. WELLE has suggested that the low moisture content of sugars might be the cause, which opinion is shared by others, who claim that piled sugar left for many months in an atmosphere of low humidity is more apt to cake than under other conditions.

Since the French Government secured the monopoly of the buying and the selling of alcohol (other than that distilled from fruit and grapes, and used for human consumption) enormous stocks have accumulated. It is now reported that a law is about to the promulgated requiring importers and producers of petrol, benzol, benzine, and other spirits used as motor fuel to purchase from the State a quantity of alcohol to make a mixture of a certain strength. Generally, this may contain about 10 per cent. of alcohol; but the State is empowered to fix both the percentage and the price of the composite fuel.

Customs regulations providing for the use of the double polarization (in preference to the direct polarization) method of determining the sucrose content of molasses and syrups, for the imposition of duties under the Tariff Act, were promulgated on December 12th by the U.S. Treasury.

The Science of the Clarification of Cane Juice.[1]

By H. EGETER.

Introduction.

Raw juice as obtained from the sugar cane by crushing in mills is a cloudy liquid, grey to brownish-green in colour, containing substances in molecular solution, in colloidal solution, and in coarse dispersions, water being the dispersion medium. In molecular solution there are present: sucrose, dextrose, levulose; the cations, sodium, potassium, calcium, magnesium, and iron, in equilibrium with the anions of the organic acids, acetic, glycolic, oxalic, malic, succinic and the acid radicles of the inorganic acids, silicic, phosphoric, etc., all these resulting in an acid reaction.

In colloidal solution there are: gums, pectins, proteins, silicic acid, clay, colouring matter, etc. Most of these constituents are emulsoids, capable by their protective action of causing substances (e.g., clay) to remain in colloidal solution, or readily to pass into colloidal solution. Then in coarse dispersion one finds clay, cane wax, particles of bagasse, and also air.

Now from this extremely complex system, sucrose is to be extracted with as low a loss and at as low a cost as possible. In the clarification of the juice the emulsoids "coagulate," principally as the result of heat, and the manner of applying the heat certainly exerts some influence on the size and the nature of the particles thus formed, though on this point little is yet known. The quantity, size, and form of these particles are factors which differ in the case of each juice, and mainly determine what is known as the "nature of the juice."

Conditions of an Ideal Clarification.

In an ideal clarification the following conditions should be fulfilled:—(1) Substances which raise the viscosity must be removed as completely as possible. (2) Non-sugars must be eliminated as completely as possible. (3) During clarification and also later, a high temperature, and a pronounced acid or alkaline reaction, must not occur simultaneously. (4) Lastly, especially in white sugar manufacture, the colouring matters must be removed as completely as possible, while during the subsequent operations their re-formation must be avoided.

(1) Removal of Viscous Substances.

The substances which increase the viscosity of the juice are mainly the emulsoids, the removal of which troublesome constituents can be brought about in different ways. Firstly, the juice can be submitted to an ultra-filtration, e.g., using the Plauson press.[2] Undoubtedly, if it were possible to solve the practical difficulties connected with this apparatus, it would form the best method of juice purification, since the removal of the colloids would be complete, while the greater part of the colouring matters would be separated as well. However, the Plauson press does not appear so far to have been adapted to practice,[3] and perhaps would not be capable of maintaining a sufficient capacity in operation. Secondly, one may endeavour to separate the emulsoids by surface energy (adsorption), either by means of a precipitate which is formed in the juice itself, or else by means of a preparation which is added. Thirdly, the emulsoid colloids may be flocculated by electrolytic action.

But these last two methods give slight results; and coagulation by heating succeeds much better. A few years ago, NOEL DEERR[4] pointed out that by far

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[1] Abridged translation from *Mededeelingen van het proefstation voor de Java-suikerindustrie*, 1922, No. 7.

[2] U.K. Patent, 155,834; *I.S.J.*, 1921, 594, 680. [3] *I.S.J.*, 1921, 401. [4] *I.S.J.*, 1916, 502, 558.

the greater part of the impurities removed by an intense method of juice clarification (as the carbonatation process) are eliminated simply as the result of heat, or at any rate are converted into the form of a coarse dispersion.

At the present time, juice clarification consists of two stages: (1) neutralization, and conversion of the impurities into a form adapted for mechanical removal; and (2) the mechanical removal itself. When, however, a great part of the emulsoids are coagulated by heat, and when the attempt is made straightway to filter them off, great difficulty is encountered in practice; and indeed the operation is only possible on the laboratory scale by the use of an asbestos filter, or after the addition of infusorial earth. A solid precipitate capable of giving a structure to the soft precipitate is necessary.

This can be done in two ways. In the first by forming the precipitate in the juice itself, e.g., with lime and sulphurous, carbonic or phosphoric acid; and in the second by adding finely ground or crystalline substances to the juice. If the first method be adopted, one always effects a good conglomeration of the particles on the structure-forming precipitate, which generally has a much higher specific gravity than the soft particles. The greater the amount of structure-giving precipitate, and the better the fixing of the soft particles, then the more efficient subsiding will be. If, on the other hand, a structure-forming precipitate is added (and not actually internally formed in the liquid), then the conglomeration of the soft particles is very incomplete. Under the microscope it is seen that only some of these unite with the larger solid particles; and one also observes that the liquid is cloudy, and that the structure-giving particles and the soft smaller ones are present separately. Owing to the difference in specific gravity, the two kinds of particles no longer mix together, so that if filtration is not impossible, it is at any rate very difficult.

In the clarification methods used at the present time, the separation of the emulsoids is far from complete; and we are as yet unacquainted with the causes which bring about such great differences in the quantity of coagulated emulsoids under apparently the same conditions.

(2) REMOVAL OF NON-SUGARS.

In the consideration of the removal of non-sugar substances, which are not colloids, one enters the domain of chemical clarification proper, involving (it may be) the rendering insoluble of substances, as the result of changing the reaction of the medium, or as the result of the formation of insoluble salts. But here also a rôle is played by the entrainment of substances that are not really insoluble; and here also (as in the removal of the emulsoids) the degree of dispersion of the substances to be eliminated is decreased, so as to allow of their mechanical separation.

There exists (theoretically at any rate) the possibility of effecting a separation without altering the degree of dispersion of the substances to be removed. Sucrose, dextrose, and levulose possess a much larger molecule than do the other substances with are present with it, so that they might be isolated by the same method as the colloids, viz., ultra-filtration. Since, however, for this operation very high pressures would be required, probably amounting to some thousands of atmospheres, such a procedure can hardly be regarded as practical.

Disregarding this last method, it would appear that in this phase of clarification we cannot get much beyond the stage which has now been reached. For example, precipitation processes involving the use of baryta are too involved and difficult for practical application.

(3) HIGH TEMPERATURE AND PRONOUNCED REACTION.

Owing to the simultaneous occurrence of the two factors, a high temperature, and an alkaline reaction, the decomposition of dextrose and levulose occurs with all its detrimental results. In the first place, products are formed which darken the juice and increase its viscosity, the ground gained as a consequence of clarification being lost; and more than that. Dextrose and levulose disappear, but give place to substances capable of strongly increasing the solubility of sugar in the final molasses. Lastly, lime is lost, being used up for the neutralization of the acids which are formed.

On the other hand, by the simultaneous occurrence of a high temperature and an acid reaction, inversion of sucrose arises. Hence, since it is necessary in our present methods of juice clarification in any case to make use of heat, it would seem to be better to make the reaction precisely neutral. To do this always, however, is hardly possible in practice, for the juice must at one time be somewhat alkaline, or else somewhat acid. Since the result of "glucose" decomposition is much more serious than a small loss of sucrose, it is preferable to work somewhat on the acid side, and this reaction must so be adjusted that later in the evaporators the juice cannot become alkaline.

In carrying out the ordinary defecation method at the present time, so little lime may be added that the juice just reacts acid, owing to the presence of uncombined acids. Formerly, so much lime was added as to impart an alkaline reaction, but some have abandoned this procedure. Anyway, it is certain that the defecation method does not yield much of a result.

Regarding defecation-sulphitation, when the juice is made just acid with sulphurous acid it does not become alkaline during evaporation, or later. Quite otherwise is the position in the carbonatation process, because here a juice which has been made acid with carbon dioxide becomes alkaline during evaporation. But this disadvantage is overcome by filtering the juice when slightly alkaline, and afterwards making it somewhat acid with sulphur dioxide.

(4) REMOVAL OF COLOURING MATTERS.

Coming finally to the question of the colouring matters, it may be remarked that our knowledge of this is only too small. In general, however, it may be said that the colouring matters present in cane juice are of a colloidal nature, as is evident on passing this liquid through an ultra-filter. They are very difficult to remove, the reason for which is found in the fact that they are protected by very resistant emulsoids.

It is striking to point out that by far and away the greatest part of the colouring matters (present, for example, in massecuite) has been formed during the different operations. Cane juice, when it has been kept away from contact with iron (which forms dark iron-polyphenol compounds), and when it has been concentrated to a syrup at a temperature lower than 45° C., is ordinarily light-coloured, lighter even than the lightest thick-juice obtainable in practice. Hence it follows that in the methods of juice clarification applied at the present day, in spite of all that may be done, we retrogress rather than progress, so far as the colouring matters are concerned.

In order to remove colouring matters, or else to render them less harmful, the following means are available:—

(1) Chemical reagents, which oxidize or reduce, the latter alternative being almost exclusively used at the present time. By the addition of sulphurous acid,

for example, a distinct decolorization is to be observed, which advantage, however, is later lost, owing to oxidation. Oxidation is little employed, though recently it was stated that by means of ozone good results can be realized,[1] but it may be added that in these investigations it was not mentioned whether the bleaching effect obtainable is of a permanent nature.

(2) Variation of the reaction of the medium in which crystallization takes place. This may be of influence in determining whether or not the colouring matters crystallize out with the sucrose (for example, the crystallizing out of iron-polyphenol compounds in an acid medium).

(3) Coagulation on heating. By the coagulation of the emulsoids some of the colouring matters are at the same time removed from solution.

(4) Adsorption by the structure-giving precipitate. Here the question may be posed whether it matters if the precipitate is produced in the body of the juice, or is formed outside and afterwards added.

(5) Decolorization with an adsorbing carbon. This at first thought may appear the most objective method; but in its application great technical and economical difficulties are connected.

(6) Lastly, may be mentioned ultra-filtration. If this means were a practical one, its application would very probably make the use of other means supererogatory.

According to this review, therefore, the question of the colouring matters of cane juices must be regarded as being far from solved; and measures having as their object the prevention of their formation during the different operations probably deserve preference.

"To my mind[2] there are ten big factors that make for success in a chemist. These vary with conditions, but for a laboratory worker each is very important: honesty, accuracy, speed, thoroughness, observation, ingenuity, loyalty, personality, health, and education. The first three are the most vital and refer to the physical accomplishment of the work. . . . . It is unfortunately true that they seem to be the chief and only assets of some chemists. The next three points are functions of the mind and usually come as the result of experience. It has been said that a man who can make an analysis is worth a hundred dollars; a man who can explain the analysis is worth two hundred dollars; while a man who can interpret and apply the analysis has no limit in value. In most lines of work, thoroughness comes first, but in chemistry, or rather in analytical or research chemistry, it *must* take the place indicated. . . . . Loyalty, personality, and health make the leader—the man for whom and with whom you like to work. The last requirement—education—fills the chinks. It is the most easily obtained, but too often is present as a 'trace only'. . . . . ."

Carbons are being used for purposes other than the decolorizing and purifying of impure liquids. For example, the GENERAL NORIT Co. have recently protected processes for drying gases,[3] and for the treatment of liquids with gases; while E. R. SUTCLIFFE has disclosed a method of recovering carbons which have been used for adsorbing gases or vapours,[4] namely by treating them with superheated steam. Another use is in the manufacture of formaldehyde, according to a process patented by the FARBWERKE VORM. MEISTER, LUCIUS & BRÜNING,[5] in which a mixture of methylene chloride vapour and water vapours at a raised temperature is passed over a porous absorbent material, as activated wood charcoal or kieselguhr, the condensate consisting of a hydrochloric acid solution of formaldehyde. Yet another application is disclosed in the specification of F. E. THOMAS, and BAKER, SONS, & PERKINS, LTD.,[6] by which decolorizing carbon preferably in a very fine state of division is incorporated with paper pulp intended for the preparation of filter paper, which thus has the property of retaining very fine precipitates and colloidal matters.

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[1] Here reference appears to be made to the recent work carried out by Dr. C. W. SCHONEBAUM. See *I.S.J.*, 1922, 28 *et seq.*
[2] An anonymous writer in *J. Ind. Eng. Chem.*, 1922, 14, No. 9, 831.
[3] U.K. Patents, 188,666 and 188,667. [4] U.K. Patent, 188,723.
[5] U.K. Patent, 189,432. [6] U.K. Patent, 189,562.

Recent Work in Cane Agriculture.

Outbreak of Pseudococcus Sacchari on Sugar Cane in Egypt. *W. J. Hall. Bulletin 26, 1922. Ministry of Agriculture in Egypt.*

The whole cane industry in Egypt appears to be threatened by an overwhelming attack of mealy bug on the canes. This pest which is of fairly wide distribution all over the world has been allowed to get thoroughly out of hand, and this is traced to two distinct causes. The first of these is stated to be the careless cultivation due to the high prices of sugar during the war and the second the introduction of J 105 in place of the old red Biladi cane. The thin, hardy Java seedling has as usual firmly adhering leaf sheafs within which the mealy bugs can obtain a secure lodgment and work undisturbed. Its yield of canes in the field is however so much greater than that of the tropical Biladi, which sheds its leaves normally, that the latter is now only retained in small quantities for the supply of canes for chewing purposes. One other defect of the new cane is that its juice is liable to very rapid deterioration if not taken to the mill immediately after cutting. The infection is of such a thorough going character that, unless speedy action be taken, this promising industry appears to be doomed. The area under sugar cane in Egypt averages about 55,000 acres which produce something under two million tons of cane annually, and the great bulk of this is made into sugar. Most of the cane is grown in Upper Egypt and serves to supply some half-dozen factories, all of which except one belong to the same company, which however grows little cane itself and depends on the felaheen for its supplies. The only feasible remedies appear to be the complete control of the planting material and the destruction of the loose trash on the fields. And, besides these measures, it is suggested that the cane should not be allowed to be on the same land for more than two years and if possible should be grown in large blocks. The first remedy should not be impossible if Government aid can be called in, but the second is more difficult because the trash is not only used for fuel in the mills but also in the neighbouring villages. This also will require legislation. Before the war coal was used in the factories, but trash was substituted because of its high price; as the cost of coal has now fallen to near pre-war level, there should be no great difficulty in the way of reverting to it in the mills, but the deprivation of such a convenient fuel for the villagers in a land where this commodity is always scarce will not be so easy. Every scrap of the crop residue is covered by the minute coccids in various stages of development and it must be sedulously destroyed on the field to prevent the spread of the pest. For the same reason the seed cane must be completely cleared of the adherent leaf sheaths under which the insects congregate and treated with disinfectants on the field where the cane is cut. Of the various chemicals used nothing apparently can compete in effectiveness and cheapness with kerosene emulsion, and the preparation of this, being difficult, must be in the hands of the factory officials. The natural enemies are mainly rats and a couple of moulds, but are quite ineffective owing to the sheltered position of the mealy bug: the introduction of ladybirds which is being considered will doubtless be of use in controlling the pest once the canes are freed, but can hardly be expected rapidly to exterminate it in its present stage of omnipresence. Not only are the canes weakened by the sucking of the myriads of insects but the sweet, gummy honey dew which they extrude makes it impossible to crystallize the sugar in the juice, and the matter requires very urgent attention. If the measures suggested are energetically taken in hand and rotation practised, it is considered that, especially if large blocks of cane can be introduced, the pest should be under control in four or five years, when the trash might again be available for the village fires.

PAPERS ON INSECTS OF SUGAR CANE. *The Journal of the Department of Agriculture and Labour of Porto Rico. Vol. VI, No. 1. January, 1922.*

Of these papers, one of especial importance to cane agriculture, on the influence of burning the trash on the abundance of moth borer by G. N. WOLCOTT, was reviewed in our January number. Three other papers, mainly by the same author, are included in the same number of the Porto Rican Journal. The first is a long and detailed account of various efforts to introduce insect parasites into the island, chiefly in connexion with the spread of white grub. This campaign was started by VAN DINE, the first entomologist, because of the difficulty experienced in the control of these serious pests in the canefields, and at first the United States were indented on because of the greater knowledge there of similar pests and their parasites. A full list of the various introductions is given with the results obtained, and this is illustrated with figures of the parasitic wasps and flies received from the United States, Barbados and other places. But very few of these trials appear to have been successful, due in many cases to the irregular and tardy steamship services connected with the island. More success was obtained in bringing in parasites or predators of the mealy bug (Pseudococcus) which is widely spread and undoubtedly injurious. But from the practical point of view little result has been noted from this importation because of the protection afforded to the pest by the leaf sheaths, under which it congregates, especially as the gummy exudation (honey dew) of the mealy bug tends to considerably retard the normal shedding of the leaves.

In another paper WOLCOTT gives an annotated list of 32 insects attacking sugar cane in Santo Domingo, asterisks being placed opposite to those which are also found in Porto Rico. The list collects into small compass the scattered work of various observers, and is of special importance to Porto Rico because of the large shipments of canes from Santo Domingo for milling in the island factories. A third paper, prepared by T. H. JONES but still unfinished when he left the island and brought up to date by WOLCOTT, deals with the caterpillars which eat leaves of the sugar cane in Porto Rico. The seven species enumerated are described and illustrated, but must be considered as only minor pests in the fields, being, fortunately, largely kept under control by parasites. The value of this series of papers is enhanced by the addition of a copious literature of local papers at end of each.

FIELD EXPERIMENTS ON SUGAR CANE SMUT IN MANILA. *H. A. Lee and M. G. Medalla The Philippine Agricultural Review. Vol. XIV, No. 4. 1922.*

This disease, caused by *Ustilago sacchari*, is widely diffused in the cane fields of Luzon and appears to attack Luzon White and Pampagna Red most severely, while Yellow Caledonia, H 109 and Louisiana Striped do not seem to be affected by it. It increases with ratooning and this is one of the factors which limit ratooning of the sugar cane in the island: some ratooned fields were observed in which four out of every five clumps were attacked. The experiment in Manila was inaugurated to determine the extent of transmission of the disease through the seed cane, to indicate the losses sustained by the planters, and to determine if possible if there were any other means by which the disease could be spread. Because of its extreme susceptibility, the Uba cane, which is largely grown for fodder in the Philippines, was used in the experiment. Rows of sets from diseased and healthy clumps were alternated, together with healthy sets washed in the same receptacle as the diseased. The germination of the sets in the diseased rows

was 58 per cent. as against 97 to 100 per cent. in the healthy. One month after planting 23·8 per cent. of the diseased rows were seen to be affected but none of those from the healthy sets; and at the age of six months the figures were 84 for the diseased rows, 3 for the healthy and 8 for the sets which had been washed with the diseased ones.

In a second experiment the germination was 62 per cent. for healthy, and only 6 for diseased sets, and after six months, while no plants from healthy sets were attacked, 43 per cent. were so in the diseased rows. From these experiments the conclusions were drawn that germination is greatly affected by smut, sets from diseased plants pass the smut on in a high degree, no yield of canes is obtained by planting sets from smutted canes, the spread of the disease to healthy canes six months old is very slight, but is distinctly appreciable when normal sets are washed in the same water as diseased. The latter is thus a distinct method of spreading the disease.

OBSERVATIONS ON PREVIOUSLY UNREPORTED OR NOTEWORTHY PLANT DISEASES IN THE PHILIPPINES. DISEASES OF THE SUGAR CANE. *H. A. Lee. Ibid.*

This is an annotated list of 22 sugar cane diseases met with by the mycologist in the islands. Pineapple disease is widely spread and causes great but preventible losses, some fields noted having been entirely replanted, while others were abandoned through lack of germination. Rind disease (Melanconium) is given its true value as a non-parasite, and only attacks canes killed by other causes. Sclerotium disease (*Sclerotium Rolfsii*) is found very commonly, but there are no data as to the damage caused by it. Top rot similar to that described by WAKKER in Java in 1890 occurs sporadically, but the losses caused by it are negligible. Mosaic is of widespread distribution and has probably been for a long time in the country: its occurrence in the Philippines was recently dealt with in this Journal.[1] Rust (*Puccinia Kuehnii*) is rather common on Louisiana Striped, Rose Bamboo and Black Cheribon and causes slight injury. Wilt (*Cephalosporium sacchari*) previously reported from India and South Africa is present and although not widespread kills any canes attacked by it. Three root diseases are present. *Marasmius sacchari* has been observed but is not considered to cause extensive injury. The same applies to *Dictyophora phalloidea*, frequently noted in Philippine literature as causing root disease, whereas the author considers it to be a harmless saprophyte. *Aeginetia indica*, a parasitic flowering plant, on the other hand, is regarded by LEE as one of the most disastrous cane diseases where it occurs. Fortunately it appears to be confined to Rizal, Laguna and Batangas provinces. A considerable number of leaf spot diseases are enumerated, most of which are described as of little economic importance, although they must render these important organs of the plant body less efficient. *Colletotrichum falcatum*, well known in other sugar countries as red rot of the stem but also found attacking leaves to a less degree, in the Philippines is solely a leaf disease according to LEE's observations. The leaves are reddened and subsequently browned and killed. This is the first report of its killing leaves in the country and is stated to appear during warm, damp weather and to disappear when dry conditions supervene. Banded sclerotial disease described from India and Java has been noted for the first time in the local cane fields. Downy mildew or leaf stripe caused by the fungus *Sclerospora sacchari* was introduced into the Rizal province from Formosa in 1920. Upon its discovery the affected cane, about one hectare in extent, was promptly cut and burned and the stubble dug in and also burned over, and since this action it has

[1] *I.S.J.*, 1923, p. 83.

not again been observed. Fiji disease is considered to be undoubtedly the most serious cane disease in the Philippines. Its occurrence there was noted in a recent issue of this Journal.[1] Red vascular disease of the cane causes a wilting of the leaves and is characterized by a reddening of the vascular strands. In some respects it resembles the Sereh of Java, but is regarded as quite distinct by the author. It is common on H 109 and has been observed on Louisiana Striped and Negros Purple, and appears to be identical with a disease which the author had pointed out to him in Hawaii. Sereh has been frequently reported in the Philippines, but LEE regards these reports as incorrect.

C. A. B.

Milling Control in Java during the 1922 Crop.

In recent issues of the *Archief*[2] a series of contributions from the Experiment Station of the Java sugar industry have appeared on the subject of the control of milling during the 1922 crop, these contributions being issued at fortnightly intervals. A number of interesting data are included, some of which are here summarized.

JUICE WATER LOST PER 100 OF FIBRE.

During the second fortnightly interval, figures were forthcoming from 84 factories, during which period the results were practically the same as in the previous one. This was shown by the value expressing the "juice water lost per 100 of fibre," which is the best factor for judging the milling operation.

It states how much useful juice remains unrecovered from the bagasse, differences owing to the fibre content of the cane being eliminating by calculating on a basis of 100 parts of fibre. This seems to be the fairest way of criticizing milling work.

Calculation of the factor is simple: Juice water lost per 100 of fibre in the bagasse of the last mill $= \dfrac{\text{Brix of the bagasse from the last mill}^{3}}{\text{Brix of the juice from the first mill (per unit of water)}} \times \dfrac{100}{\text{Fibre of the bagasse from the last mill}}$.

For the Brix of the bagasse from the last mill, one takes, as customarily: $\dfrac{100 \times \text{Polarization of the bagasse from the last mill}}{\text{Purity of the juice from the last mill}}$; while for the Brix of the juice of the first mill (per unit of water): $\dfrac{\text{Brix of the juice from the first mill}}{100 - \text{Brix of the juice from the first mill}}$, which calculation can be avoided by reference to the table on page 139 of Bulletin No. 3 of the Technical Department of the Experiment Station, Semarang.[4] Then the fibre in the bagasse from the last mill = dry substance of the bagasse from the last mill *minus* the Brix of the bagasse from the last mill.

Hence, the data necessary for the calculation of the juice water lost are: Polarization of the bagasse; quotient of purity of the juice from the last mill; dry substance of the bagasse; and the Brix of the juice from the first mill. Some of the returns[5] obtained from the 84 factories which participated in this control are as follows:—

[1] *I.S.J.*, 1922, pp. 536 and 591
[2] 1922, 30, No. 27, 469-476; No. 32, 573-583.
[3] That is, soluble solids present in the bagasse from the last mill.
[4] *I.S.J.*, 1922, 209. [5] Only a few are here reproduced.—ED., *I.S.J.*

Milling Control in Java during the 1922 crop.

Factory No.	Installation.	Method of maceration.[1]	Maceration effect.	Per 100 Fibre. Maceration water	Water in bagasse of last mill.	Juice water in bagasse of last mill.	Water in cane.	Brix-free cane water.	In 100 Cane. Undiluted raw juice.	Fibre.	Brix extraction.	Sugar extrac	W. P. Q.[2]
2	4	c2	46	192	88	40	629	30	79·3	11·7	93·4	94·0	96·8
5	cr3	b1	31	111	104	56	569	32	74·6	12·7	89·7	90·1	95·3
6	3	b2	32	167	99	53	548	21	75·7	13·1	90 0	90·8	99·2
7	3	b2	28	99	103	58	493	24	72·2	14·3	87·7	88·8	96·6
8	sn3	b2	34	88	97	51	527	28	74·4	13·6	89·9	91·0	98·0
12	3	b2	24	118	120	67	463	25	68·8	15·0	84·7	85·5	93·6
12	3	b2	27	81	102	59	370	28	63·6	18·2	82·9	83·6	92·0
15	3	b2	30	131	96	54	539	18	75·8	13·2	89·7	90·2	99·6
16	cr3	b2	38	100	108	51	556	27	75·6	12·9	90·4	90·7	97·1
17	cr4	c14	44	139	113	46	601	34	76·8	12·3	91 9	92·4	94·2
17	cr4	c14	23	124	107	62	656	—19	82·3	11·4	90·8	91·4	100·7
21	3	b2	41	110	109	48	652	42	77·3	11·2	92·1	92·7	96·8
22	cr3	b2	31	127	103	55	568	35	74·4	12·7	89·7	90·3	94·8
29*	4	—	37	98	86	47	480	15	75·1	14·4	90·0	90·6	97·0
32	cr3	b2	28	108	103	58	481	15	72·9	14·6	87·6	88·4	97·3
34*	3	b2	46	67	85	39	550	60	73·0	13·0	92·1	92·5	93·9
42	4	c9	39	76	103	49	567	47	73·7	12·8	90·7	91·2	91·3
43	cr4	c14	50	117	105	39	608	42	77·0	12·1	93·1	93·6	94·0
44	4	c1	46	147	92	41	652	39	78·9	11·2	93·4	94 0	95·3
45	cr3	b2	38	90	98	48	512	22	74·8	14·0	90·2	90·8	98·3

Those factories in the above tabulation indicated by an asterisk* still determine the fibre in the bagasse by hot extraction, then calculating the Brix of the bagasse from the last mill from: dry substance of the bagasse from the last mill *minus* the fibre of the bagasse from the last mill. However, the fibre thus directly determined is 1 to 1·5 per cent. lower than if it were calculated from: dry substance of the bagasse from the last mill *minus* Brix of the bagasse of the last mill, as most of the factories have done. In order to bring the factories marked* into correspondence with the others, the formula (already stated) expressing the Brix of the bagasse of the last mill:

$$\frac{100 \text{ polarization of the bagasse from the last mill}}{\text{purity of the juice from the last mill}},$$

was applied.

Furthermore, the results of factories have been arranged according to the factor "juice water lost per 100 of fibre," commencing with those showing the highest. Four groups have been separated, depending on the milling installation; while besides the factor are also given the sugar extraction, and the maceration per 100 of fibre.[3]

[1] The interpretation of this notation is as follows: c2 = In a 4-mill installation, some of the juice from the fourth mill on bagasse of first and water on the bagasse from the second and third mills. b1 = In a 3-mill installation, water on the bagasse from the second mill b2 = In a 3-mill installation, all the juice from the third on the bagasse from the first mill water on the bagasse from the second. c14 = In a 4-mill installation, all the mixed juice from the third and fourth on the bagasse from the first mill water on the bagasse from the second and third mills. c9 = In a 4-mill installation, all the juice from the third on the bagasse from the first, all that from the fourth on the bagasse from the second, and water on the bagasse from the third. c1 = In a 4-mill installation, water on the bagasse from the second, and water on the bagasse from the third.

[2] W.P.Q. = Quotient of water extraction = quantity of water originating from the cane, per 100 of that capable of being extracted.

[3] Only the average figures of all the factories taking part in the compilation are here reproduced.

	Three Mills. (20 examples.)	Crusher and Three Mills. (22 examples.)	Four Mills. (12 examples.)	Crusher and Four Mills. (34 examples).
Juice water lost per 100 of fibre	54	53	44	42
Sugar extraction	90·1	90·7	92·6	93·1
Maceration per 100 of fibre	109	116	127	142

In the first contribution it was shown that the sugar extraction does not run parallel with the juice water lost, because it so much depends on the juice content of the cane. That the average values for the four groups of installations show the same order for both extraction and juice water lost is the result of the circumstance that in the case of each group the average juice content of the cane was about the same.

Regarding the figures for the maceration per 100 of fibre, these vary from 65 to 226. No distinct effect of the degree of maceration on the quantity of juice lost in the bagasse can be detected in these results. So for a better insight into the matter, the figures have been divided into two groups according to the number of mills, and according to the degree of maceration, these figures being further arranged according to the maceration per 100 of fibre in stages of 10, and the corresponding juice water lost stated at the same time.

JUICE WATER LOST PER 100 OF FIBRE.

Maceration per 100 of Fibre.	3-Mill Installation. 1 Water Maceration. Methods *b1* and *b2*	3-Mill Installation. 2 Water Maceration. Method *b4*	4-Mill Installation. 1 Water Maceration. Methods *c6*, *c7*, *c9*	4-Mill Installation. 2 Water Maceration. Methods *c1*, *c2*, *c3*, *c14*
60— 70	47	—	—	—
70— 80	—	—	49	—
80— 90	50	—	47	—
90—100	55	—	44	—
100—110	54	—	48	—
110—120	52	59	45	40
120—130	49	—	—	43
130—140	54	48	38	44
140—150	56	—	44	42
150—160	64	—	30	37
160—170	53	—	—	35
170—180	—	—	49	27
180—190	—	—	—	54
190—200	—	—	—	40
200—210	—	-	—	39
Average	53	54	44	40

The irregularity of these figures shows that the question whether a higher maceration results in an appreciable diminution in the juice lost in the bagasse depends wholly on conditions. In connexion with the cost of the extra fuel, it is necessary that one should determine the economic degree of maceration.

An important question is whether maceration should be applied at the second mill. No advantage of such an application is to be discovered in the figures compiled, when comparing the juice water lost using the *b1* and *b2* methods of maceration. It was seen that the average of the *b1* method is 52, that is one lower than that of the *b2* method. Anyway, by a temporary stoppage of the maceration it is easy enough to ascertain whether this has any effect on the juice lost. If the difference is not considerable, then, having regard to the danger of sugar decomposition in consequence of the greater time during which the juice is in circulation, it is preferable to abandon this mode of applying water.

Volumetric Determination of Reducing Sugars by Means of Fehling's Solution, with Methylene Blue as Internal Indicator.[1]

By J. HENRY LANE, B.Sc., F.I.C., and LEWIS EYNON, B.Sc., F.I.C.

INTRODUCTION.

Soxhlet heated a known volume of Fehling's solution to boiling in an open dish and added the sugar solution until the copper was completely reduced. No great accuracy was possible by this procedure, even in highly skilled hands By boiling the solution in a flask instead of an open dish, to diminish back-oxidation, and by using certain indicators, the degree of precision of the volumetric method was considerably increased, and a moderate amount of practice sufficed to obtain results accurate to within 1 per cent. of the amount of sugar present. Only external indicators have hitherto been proposed for this purpose, and their use has the disadvantage that the interruption of boiling during the making of the indicator tests gives opportunity for back-oxidation of the cuprous oxide. This drawback applies particularly to the ferrocyanide indicator, for which a small quantity of the reaction liquid has to be filtered before testing. With the thiocyanate indicator proposed by LING, RENDLE and JONES,[2] less time is required for making the spot tests and the error of the method is accordingly reduced.

METHYLENE BLUE AS INDICATOR.

We have found that the disadvantages attending the use of an external indicator can be avoided altogether by the use of methylene blue as internal indicator. It has long been known that in hot alkaline solutions methylene blue is reduced, i.e., decolorized, by aldoses and ketoses, and some 15 or 20 years ago it was proposed to make use of a solution of methylene blue, rendered alkaline with sodium carbonate, to determine minute quantities of invert sugar such as are present in refined sugar. A similar method was also suggested for the determination of reducing sugar in urine, but it does not appear to have been widely used, and we have been able to find no reference in the literature to any suggestion that methylene blue might act as an indicator in presence of Fehling's solution. Yet it acts admirably. So long as the slightest trace of unreduced copper remains in the liquid the methylene blue retains its colour, but as soon as all the copper is reduced the methylene blue is decolorized at the boiling temperature. The decolorization is almost instantaneous. The action of the indicator is reversible, addition of a trace of copper salt restoring the colour immediately.

We have found that the end-point indicated by methylene blue is the same as that shown by ferrocyanide, i.e., it does actually coincide with the removal of the last trace of cupric ions from the solution. The range of usefulness of the indicator is greater than that of ferrocyanide; it may be used with turbid liquids which do not filter well enough for satisfactory ferrocyanide tests, and the presence of starch, proteins, etc., in the liquid does not interfere with its action. For example, lactose may be determined directly in milk, suitably diluted, without any previous clarification.

The use of a satisfactory internal indicator with Fehling's solution obviously permits the volumetric method to be applied with much greater precision than hitherto. Errors due to back-oxidation of the reduced copper during the pauses

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[1] Abridged from the *Journal of the Society of Chemical Industry*, 1923, 42, No. 4, 32T–37T.

[2] *I.S.J.*, 1908, 357-8.

for external indicator tests are avoided entirely, since the colour change of the methylene blue in the reaction liquid may be detected whilst the liquid is in ebullition on a wire gauze. To attain the maximum of accuracy, however, it is necessary to adhere to a consistent procedure in the manner of adding the sugar solution to the Fehling's solution. It is well known, for example, that if the sugar solution is added in increments of say 5 c.c. and the liquid boiled for 10 or 15 seconds after each addition, the total volume required will not be exactly the same as if the whole of the sugar solution is added at once. In the former method of operating, the personal equation is difficult to eliminate, since different operators may vary somewhat in judging the approach of the end-point and consequently in the manner of adding the final portions of the sugar solution.

STANDARD METHOD OF PROCEDURE.

In the present study we have endeavoured to apply the new indicator in such a way as to confer the maximum possible degree of precision on the volumetric process and to eliminate the personal factor as far as possible. To this end we have devised the following method of procedure—our Standard Method—to which all the accompanying tables refer:—

The Fehling's solution employed is that known as Soxhlet's modification and is prepared by mixing equal volumes of solutions A and B:—(A) 34·639 grms. of pure crystallized copper sulphate $CuSO_4,5H_2O$, is dissolved in distilled water and made up to 500 c.c. (B) 173 grms. of Rochelle salt and 50 grms. of sodium hydroxide are dissolved in distilled water and made up to 500 c.c. The indicator is prepared by dissolving 1 grm. of methylene blue[1] in water and making up to 100 c.c. This solution will keep for months without change.

10 or 25 c.c. of Fehling's solution is measured into a flask of 300 to 400 c.c. capacity, and treated cold with almost the whole of the sugar solution required to effect reduction of all the copper, so that if possible not more than 1 c.c. is required later to complete the titration. The approximate volume of the sugar solution required is ascertained by a preliminary incremental titration which will be described further on. The flask containing the cold mixture is heated over a wire gauze; after the liquid has begun to boil it is kept in moderate ebullition for two minutes, and then without removal of the flame, 3–5 drops of the methylene blue indicator are added, and the titration is completed in one minute further, so that the reaction liquid boils altogether for three minutes without interruption.

The indicator is so sensitive that the end-point can be determined to within 1 drop of the sugar solution in many cases. The complete decolorization of the methylene blue is usually sufficiently well indicated by the whole reaction liquid, in which the cuprous oxide is continuously churned up, becoming bright red or orange in colour; but in case of doubt the flask may be removed from the wire gauze for a second or two and held against a sheet of white paper on the bench, when the edge of the liquid will appear bluish if the indicator is not completely decolorized. It is inadvisable to interrupt the boiling for more than a few seconds, as the indicator undergoes back-oxidation rather rapidly when air is allowed free access into the flask, but there is no danger of this so long as a continuous stream of steam is issuing from the mouth of the flask.

In the titrations on which the accompanying tables are based, the volume of sugar solution added to the Fehling's solution before heating was about 0·4–0·8

[1] We have used samples from various chemical dealers and have found no difference in sensitiveness.

c.c. less than the total volume required, and during the third minute of ebullition this complementary quantity was added, two drops at a time at intervals of about 10-15 seconds until the colour of the methylene blue was completely discharged.

Compilation of the Sugar Tables.

Operating in this way with either 10 or 25 c.c. of Fehling's solution we have obtained very concordant results with all the reducing sugars tested, viz., invert sugar (alone and in presence of sucrose), dextrose, levulose, maltose, and lactose,[1] and we have compiled the accompanying tables for solutions of these sugars of such concentrations as to require from 15 to 50 c.c. Over the whole of this range it is possible to attain a degree of precision equal to that of any ordinary volumetric process, moderately careful working giving results agreeing to within 0·1 c.c. To save space the tables are given in a condensed form, showing only the values corresponding to integral cubic centimetres of the sugar solutions, but if necesary they can readily be expanded by interpolation. The "factors" given in the tables represent, in mgrms., the weight of sugar required to reduce the volume of Fehling's solution employed; in general, the factor for any given sugar varies appreciably with the concentration of the sugar.

In determining dextrose, levulose, or invert sugar in absence of much sucrose, the total period of boiling may range from two to four minutes or even beyond these limits without affecting the results; but in the determination of lactose or maltose, or of invert sugar in presence of a large excess of sucrose, it is desirable to adhere as closely as possible to the prescribed conditions (i.e., three minutes' total ebullition) whenever the maximum degree of accuracy is required. The table for invert sugar in solutions containing 1, 5, 10, and 25 grms. of sucrose per 100 c.c. should prove very useful in the analysis of raw sugars, molasses, etc. We have used it for more than twelve months past in such work. It may be remarked that the effect of sucrose on the factor for invert sugar is not proportional to the concentration of the sucrose, but increases less rapidly than the latter; for example, 10 grms. of sucrose per 100 c.c. depresses the factor only about half as much again as 5 grms. per 100 c.c.

Carefully purified preparations of the sugars were employed for the titrations on which the tables are based. Sucrose of high purity was obtained by recrystallizing refined sugar twice from water, as described by Maquenne,[2] 10 grms. of the product was found to reduce 35-40 mgrms. of copper in the well-known Herzfeld test for invert sugar, and 1·2 mgrms. of copper in the test recently described by Kraisy.[3] From these and other tests we conclude that the products contained less than 0·002 per cent. of invert sugar.

Our invert sugar solutions were obtained by hydrolysing sucrose with cold hydrochloric acid at the concentration employed in the Clerget-Herzfeld method of inversion. The usual method of procedure was to dissolve 9·5 grms. of pure sucrose in water, add 5 c.c. of hydrochloric acid (sp. gr. 1·19), make up to about 100 c.c., allow to stand for two or three days at 20—25° C., or for about a week at 12—15° C., and then make up to 1 litre without neutralizing, and keep in a well stoppered bottle. In this way an invert sugar solution is obtained containing 1 grm. per 100 c.c., which is sufficiently acid to prevent the development of microorganisms and which may be kept for long periods without undergoing any change in titre. We have had one such solution in use as a stock solution of invert sugar for twelve months. Shortly after its preparation 50 c.c. was neutralized, made up to 100 c.c., and titrated against 25 c.c. of Fehling's solution;

[1] Only the tables relating to invert sugar are here reproduced.
[2] Comptes rendus, 1916, 162, 212.
[3] *I.S.J.*, 1921, 347.

the volume required was 24·80 c.c. In a similar test on the same solution, twelve months later, 24·75 c.c. of the sugar solution was required, showing that no detectable amount of decomposition of the sugar had occurred during that period, although the bottle containing the solution had been opened repeatedly without any precautions against infection.

INCREMENTAL METHOD OF TITRATION.

As already mentioned, we propose the method of titration described above as the one which permits the greatest precision and the one least affected by personal factors. Since, however, the volume of sugar solution required must be known approximately in order that almost the whole of it may be added at one time before boiling, a preliminary titration is usually necessary. Our method of carrying out this titration is as follows :—

10 or 25 c.c. of Fehling's solution, in a 300—400 c.c. flask, is treated cold with 15 c.c. of the sugar solution, and without further dilution heated to boiling over a wire gauze. After the liquid has been boiling for about 15 seconds it will be possible to judge if the copper is almost all reduced, by the bright red colour imparted to the boiling liquid by the suspended cuprous oxide. If it is judged that nearly all the copper is reduced, a few drops of the methylene blue indicator are added, boiling is continued for 1-2 minutes from the commencement of ebullition, and then the sugar solution is added in small quantities, say 1 c.c. or less at a time, the liquid being allowed to boil for about 10 seconds between successive additions, until the colour of the indicator is completely discharged. If after the mixture of Fehling's solution with 15 c.c. of sugar solution has been boiling for about a quarter of a minute there appears to be still much unreduced copper, a further 10 c.c. of sugar solution is added and the whole allowed to boil for a quarter of a minute, and so on until it is considered unsafe to add a further large increment of sugar solution; boiling is then continued for 1-2 minutes, after which the indicator is added and the titration is completed by small additions of the sugar solution. It is advisable not to add the indicator until the neighbourhood of the end point has been reached, for the same reason that in the titration of iodine with thiosulphate solution the addition of starch indicator is best postponed to as late a stage as possible, viz., because the indicator retains its full colour until the end-point is almost reached and thus gives no warning to the operator to go slowly.

In this incremental method of titration we aim at giving the reaction liquid about three minutes' total ebullition after the final 10 c.c. increment has been added, but it will be readily recognized that this method of titration is not susceptible of rigid standardization. In general, no two operators would add the sugar solution in exactly the same way, nor boil for exactly the same periods, and differences of this kind are likely to affect the results, especially when the total volume of sugar solution required is large. It is for this reason that we have not adopted the incremental method as our standard method. For many purposes, however, a single incremental titration on the lines indicated above will give results sufficiently accurate, even if the tables given in the present paper are used without any correction; the error will as a rule not exceed 2 per cent. of the amount of sugar determined. Greater accuracy may be attained by making small corrections (see below) in the volume of sugar solution required by the incremental method before applying the result to the tables; the error then will as a rule be less than 1 per cent. of the amount of sugar determined. Where, however, the maximum degree of accuracy is desired, a second titration should be made by

the standard method, the whole of the sugar solution, except about 0·5–1 c.c. being added cold to the Fehling's solution, then boiled for two minutes, treated with 3–5 drops of the indicator solution, and finished in one minute as nearly as possible.

With regard to the above-mentioned corrections, which should be applied to the volume of sugar solution required by the incremental method in order to ascertain approximately the volume which would be required by the standard method, it should be pointed out that the magnitude of the correction depends upon the nature and concentration of the sugar to be determined.

In the case of invert sugar solutions free from sucrose the incremental method of titration, with either 10 c.c. or 25 c.c. of Fehling's solution, requires rather less sugar solution than the standard method. The deficit ranges from *nil* to about 1 c.c. as the total volume of sugar solution required ranges from 15 c.c. to 50 c.c. For example, if the incremental method requires 30·0 c.c. of a sugar solution the standard method will require about 30·5 c.c. Substantially the same corrections apply to invert sugar solutions containing proportions of sucrose up to about 5 grms. per 100 c.c., when titrated against 10 c.c. of Fehling's solution, but as the concentration of sucrose increases the corrections become smaller; they vanish for solutions containing about 10 per cent. of sucrose, and at higher concentrations change sign, so that for solutions containing 25 per cent. of sucrose the incremental method requires rather more sugar solution than the standard method, the excess being about 0·5 c.c. on the average. With solutions so rich in sucrose, however, it is difficult to obtain closely concordant results by the incremental method, slight differences in the duration of boiling having a marked effect on the results; discrepancies of 1 c.c. or even 2 c.c. may be encountered in duplicate titrations of such solutions by the incremental method, especially when the volume of sugar solution required is large, but these differences are not of serious importance as a rule, since the amount of invert sugar to be determined in such cases is necessarily very small.

These differences between the results of the incremental and standard methods only apply when the titrations are carried out as described above. It will be obvious that the use of methylene blue as internal indicator is not restricted to these particular methods of procedure. Any operator may standardize his own method, and some who have large numbers of routine titrations to carry out will probably wish to rely entirely upon a single titration by an incremental method. By adhering consistently to any suitable incremental procedure it will be possible for a skilled operator to obtain results almost, if not quite, as accurate as can be obtained by the standard method described in this paper, but since the personal factor is of great importance in incremental methods it is desirable that any operator who wishes to rely entirely on such a method should compile his own tables for the particular conditions of working adopted.

One further point respecting practical manipulation may be mentioned. In the methods of operating described in the present paper the flask containing the reaction mixture remains on the wire gauze over the Bunsen flame throughout the whole titration, except when it may be removed for a few seconds to ascertain if the end-point is reached. In adding sugar solution to the reaction mixture we hold the burette in the hand and bring it over the flask. The burette is fitted with a small outlet tube bent twice at right angles, so that the body of the burette can be kept out of the steam while the jet is held over the mouth of the flask. Burettes with glass taps are unsuitable for this work, as the taps become heated by the steam and are very liable to jam.

Table I.

Invert Sugar Table for 10 c.c. of Fehling's Solution.

C.c. of Sugar Solution required.	No Sucrose. Invert Sugar factor.*	No Sucrose. Mgrm. Invert Sugar per 100 c.c.	Solutions containing besides Invert Sugar: 1 grm. Sucrose per 100 c.c. Invert Sugar factor.*	1 grm. Sucrose per 100 c.c. Mgrm. Invert Sugar per 100 c.c.	5 grm. Sucrose per 100 c.c. Invert Sugar factor.*	5 grm. Sucrose per 100 c.c. Mgrm. Invert Sugar per 100 c.c.	10 grm. Sucrose per 100 c.c. Invert Sugar factor.*	10 grm. Sucrose per 100 c.c. Mgrm. Invert Sugar per 100 c.c.	25 grm. Sucrose per 100 c.c. Invert Sugar per 100 c.c.	25 grm. Sucrose per 100 c.c. Mgrm. Invert Sugar factor.*
15	**50·5**	**336**	**49·9**	**333**	**47·6**	**317**	**46·1**	**307**	**43·4**	**289**
16	50·6	316	50·0	312	47·6	297	46·1	288	43·4	271
17	50·7	298	50·1	295	47·6	280	46·1	271	43·4	255
18	50·8	282	50·1	278	47·6	264	46·1	256	43·3	240
19	50·8	267	50·2	264	47·6	250	46·1	243	43·3	227
20	**50·9**	**254·5**	**50·2**	**251·0**	**47·6**	**238·0**	**46·1**	**230·5**	**43·2**	**216**
21	51·0	242·9	50·2	239·0	47·6	226·7	46·1	219·5	43·2	206
22	51·0	231·8	50·3	228·2	47·6	216·4	46·1	209·5	43·1	196
23	51·1	222·2	50·3	218·7	47·6	207·0	46·1	200·4	43·0	187
24	51·2	213·3	50·3	209·8	47·6	198·3	46·1	192·1	42·9	179
25	**51·2**	**204·8**	**50·4**	**201·6**	**47·6**	**190·4**	**46·0**	**184·0**	**42·8**	**171**
26	51·3	197·4	50·4	193·8	47·6	183·1	46·0	176·9	42·8	164
27	51·4	190·4	50·4	186·7	47·6	176·4	46·0	170·4	42·7	158
28	51·4	183·7	50·5	180·2	47·7	170·3	46·0	164·3	42·7	152
29	51·5	177·6	50·5	174·1	47·7	164·5	46·0	158·6	42·6	147
30	**51·5**	**171·7**	**50·5**	**168·3**	**47·7**	**159·0**	**46·0**	**153·3**	**42·5**	**142**
31	51·6	166·3	50·6	163·1	47·7	153·9	45·9	148·1	42·5	137
32	51·6	161·2	50·6	158·1	47·7	149·1	45·9	143·4	42·4	132
33	51·7	156·6	50·6	153·3	47·7	144·5	45·9	139·1	42·3	128
34	51·7	152·2	50·6	148·9	47·7	140·3	45·8	134·9	42·2	124
35	**51·8**	**147·9**	**50·7**	**144·7**	**47·7**	**136·3**	**45·8**	**130·9**	**42·2**	**121**
36	51.8	143·9	50·7	140·7	47·7	132·5	45·8	127·1	42·1	117
37	51·9	140·2	50·7	137·0	47·7	128·9	45·7	123·5	42·0	114
38	51·9	136·6	50·7	133·5	47·7	125·5	45·7	120·3	42·0	111
39	52·0	133·3	50·8	130·2	47·7	122·3	45·7	117·1	41·9	107
40	**52·0**	**130·1**	**50·8**	**127·0**	**47·7**	**119·2**	**45·6**	**114·1**	**41·8**	**104**
41	55·1	127·1	50·8	123·9	47·7	116·3	45·6	111·2	41·8	102
42	52·1	124·2	50·8	121·0	47·7	113·5	45·6	108·5	41·7	99
43	52·2	121·4	50·8	118·2	47·7	110·9	45·5	105·8	41·6	97
44	52·2	118·7	50·9	115·6	47·7	108·4	45·5	103·4	41·5	94
45	**52·3**	**116·1**	**50·9**	**113·1**	**47·7**	**106·0**	**45·4**	**101·0**	**41·4**	**92**
46	52·3	113·7	50·9	110·6	47·7	103·7	45·4	98·7	41·4	90
47	53·4	111·4	50·9	108·2	47·7	101·5	45·3	96·4	41·3	88
48	52·4	109·2	50·9	106·0	47·7	99·4	45·3	94·3	41·2	86
49	52·5	107·1	51·0	104·0	47·7	97·4	45·2	92·3	41·1	84
50	**52·5**	**105·1**	**51·0**	**102·0**	**47·7**	**95·4**	**45·2**	**90·4**	**41·0**	**82**

* Mgrms. of invert sugar corresponding to 10 c.c. of Fehling's solution.

We have now had nearly two years' experience of the use of methylene blue as indicator for Fehling's solution in the analysis of sugar products such as raw cane and beet sugars, syrups, molasses, honeys, starch conversion products, malt worts and beers, and we have encountered no case in which it has not shown important advantages over other methods. It is at least the equal of gravimetric methods in point of accuracy, and incomparably more expeditious and convenient in manipulation. It is not affected by the presence of suspended matters in the liquid to be titrated, nor by the presence of substances which retain cuprous oxide in solution. We have no doubt that those interested in sugar analysis will welcome a method which eliminates much tedious manipulation, and by which at the same time the highest degree of accuracy is attainable.

Table II.

INVERT SUGAR TABLE FOR 25 C.C. OF FEHLING'S SOLUTION.

SOLUTIONS CONTAINING BESIDES INVERT SUGAR :—

C.c of Sugar Solution required.	No Sucrose: Invert Sugar factor.*	No Sucrose: Mgrm. Invert Sugar per 100 c.c.	1 Grm. Sucrose per 100 c.c.: Invert Sugar factor.*	1 Grm. Sucrose per 100 c.c.: Mgrm. Invert Sugar per 100 c.c.
15	123·6	824	122·6	817
16	123·6	772	122·7	767
17	123·6	727	122·7	721
18	123·7	687	122·7	682
19	123·7	651	122·8	646
20	123·8	619·0	122·8	614·0
21	123·8	589·5	122·8	584·8
22	123·9	563·2	122·9	558·2
23	123·9	538·7	122·9	534·0
24	124·0	516·7	122·9	512·1
25	124·0	496·0	123·0	492·0
26	124·1	477·3	123·0	473·1
27	124·1	459·7	123·0	455·6
28	124·2	443·6	123·1	439·6
29	124·2	428·3	123·1	424·4
30	124·3	414·3	123·1	410·4
31	124·3	401·0	123·2	397·4
32	124·4	388·7	123·2	385·0
33	124·4	377·0	123·2	373·4
34	124·5	366·2	123·3	362·6
35	124 5	355·8	123·3	352·3
36	124·6	346·1	123·3	342·5
37	124·6	336·8	123·4	333·5
38	124·7	328·1	123·4	324·7
39	124·7	319·7	123·4	316·4
40	124·8	311·9	123·4	308·6
41	124·8	304·4	123·5	301·2
42	124·9	297·3	123·5	294·1
43	124·9	290·5	123·5	287·3
44	125·0	284·1	123·6	280·9
45	125·0	277·9	123·6	274·7
46	125·1	272·0	123·6	268·7
47	125·1	266·3	123·7	263·1
48	125·2	260·8	123·7	257·7
49	125·2	255·5	123·7	252 5
50	125·3	250·6	123·8	247·6

* Mgrms. of invert sugar corresponding to 25 c.c. of Fehling's solution.

Clarification of Cane Juice and Syrup in the Manufacture of White Sugar, using "Suma-phos."

It is recognised that phosphoric acid, either alone or in conjunction with sulphurous acid, provides a valuable clarifying agent for the manufacture of white sugar. Any cane sugar manufacturer, without going to the expense of changing his installation, can turn out at least a part of his crop in the form of good white crystals, using only lime and phosphoric acid for the purification of his juice and syrup. He must, of course, observe certain precautions, which will be mentioned in this note.

A particularly efficient and economical grade of phosphoric acid clarifier has recently been put on the market under the registered trade name of "Suma-phos,"[1] this being a mixture of phosphoric acid and kieselguhr, containing 36–40 per cent. of the former (as water-soluble P_2O_5), and 15–20 per cent. of the latter. This is a very advantageous combination, since both of these constituents play an important rôle in clarification.

Juice Clarification.

"Suma-phos" should preferably be applied at two stages, namely: (*1*) for the clarification of the juice; and (*2*) for the clarification of the syrup. When used at the first stage, the raw juice from the mill may be treated with a solution of the clarifier (at any convenient density, say about 20°Bé.), using 2—5 lbs. of actual "Suma-phos" per 1000 gallons of juice, then with milk-of-lime in sufficient amount to precipitate practically all the phosphoric acid, a slight acidity only being allowed to remain, after which heating and subsiding follow in the usual way. Alternatively, the raw juice may be treated first with milk-of-lime in excess, and then with the solution of "Suma-phos," the final reaction again being a very slight acid indication to litmus paper. In either procedure, a particularly bulky precipitate of tricalcium phosphate is produced. This has the property of carrying down various impurities, among them gummy matters, which effect is further assisted by the kieselguhr present, so that a clear supernatent liquid is obtained on settling. When filter-pressing the "bottoms" left in the subsiding tanks, the advantage of the presence of kieselguhr is again experienced, since a hard cake capable of being easily sweetened off is formed.

Syrup Clarification.

Then in the clarification of the syrup from the evaporators (of such importance in white sugar manufacture) the "Suma-phos" may be applied in the same manner as in the case of the raw juice, that is, by successively adding "Suma-phos" solution and milk-of-lime, or alternatively milk-of-lime and "Suma-phos" solution, and allowing the syrup (which should not possess too high a density) to subside. Care should again be taken to leave the syrup very slightly acid to litmus paper; and it is most essential that the syrup going to the vacuum-pan supply tanks should be quite clear, this being a *sine qua non* in white sugar manufacture. Sometimes the procedure followed is to clarify the raw juice either with lime alone, or with lime and sulphurous acid, and then to treat the hot, alkaline or neutral evaporator-syrup with "Suma-phos" (without the addition of lime), using sufficient to impart a slight acidity to the liquor, the precipitate formed being subsided, and the clear syrup sent to the vacuum pans. This mode of treatment has several effects, viz., to precipitate soluble calcium salts; to thrown down colouring matters; and to decrease both colour and viscosity. Phosphoric acid has only a very weak hydrolysing power; and inversion of sucrose in the presence of a slight amount of it does not occur to any appreciable extent during the process of boiling in the pan. Moreover, there is a distinct advantage in boiling to grain in a slightly acid medium, namely, the production of a cleaner and brighter crystal than would otherwise be formed.

If the precautions mentioned above be carefully observed, particularly in regard to the use of a clear and slightly acid syrup for graining, the result (provided the pan-man has done his work properly) will be the production at little extra cost and trouble, of a massecuite which on washing in the centrifugals will give fine white crystals, capable of realizing a good price as a direct consumption product.

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[1] Sold by the Sugar Manufacturers' Supply Co., Ltd., of 2, St. Dunstan's Hill, London, E.C.3.

The 1923 Sugar Crop in Hayti.

His Majesty's Consul at Port-au-Prince (Mr. J. E. M. Carvell) reports that in spite of the optimism displayed earlier, it seems probable, now that the cutting of the sugar cane has begun, that this year's production will be far less than that of last season. It has been stated that the Haytian-American Sugar Company will be able to obtain 70,000 tons only of cane, as compared with 118,000 tons last year. The chief cause for this reduction is undoubtedly the lack of rain in the plain of the Cul-de-Sac. The plantations in this region belonging to the Haytian-American Sugar Company are producing only 10 tons of cane per acre in comparison with 45 to 50 tons per acre in the plain of Loogâne. Another reason put forward as an explanation of the shortage is that the planters have refused to sell their cane to the sugar company for 2 dollars per ton, less transport charges, in view of the present price of sugar in New York. They find it more profitable to sell to the small mills which produce "virgin spirit" much in demand by the rum manufacturers, and of syrup generally used by the natives and now selling at 24 cents a gallon.

American Commerce Reports.

Trend of World Sugar Production and Consumption.

The outstanding fact of the present sugar situation is that Cuba had only 8500 tons of old-crop sugar on hand at the end of last December, in contrast with the 1,200,000 ton carry-over that was causing grave anxiety a year ago. This means that with its record crop of 4,000,000 tons, Cuba disposed of 5,200,000 tons of sugar in 1922. The distribution was effected through the exportation of over 4,000,000 tons to the United States, some 850,000 tons of which (in terms of raw sugar) went to Europe after refining, and the shipment of another 850,000 to Europe direct. Thus Europe was supplied with 1,700,000 tons toward her deficit of 2,300,000 tons, most of the remainder coming from Java. The 3,000,000 tons of Cuban sugar that remained in the U.S.A., combined with the production of the United States and its possessions, was just about enough to supply the record United States consumption of nearly 5,500,000 short tons (raw sugar).

Cuba's ability in 1922 to distribute both a record crop and a record carry over was thus due in the main to a record consumption in the United States and to a European crop that fell far short of the consumption needs of that continent. This year starts with another 4,000,000 ton Cuban crop in sight, a big crop in Java, and a greatly increased production in Europe. But various decreases elsewhere, notably in the United States, have brought the world production only 125,000 tons higher than it was last year, to supply consumption needs estimated at 350,000 tons more than in 1922 and 725,000 tons larger than production.

The following table shows the present situation in sugar. Figures are in long tons and in terms of raw sugar.

Comparative World Sugar Supplies and Consumption.

Periods.	Carry over first of year,[1] Tons.	Estimated production, Tons.	Estimated consumption, Tons.	Final carry over end of year, Tons.
Pre-war	750,000	17,500,000	17,500,000	750,000
1920-21	1,216,000	16,682,000	16,198,000	1,700,000
1921-22	1,700,000	18,183,000	18,680,000	1,203,000
1922-23	1,203,000	18,308,000	19,035,000	476,000

Consumption figures for 1923 are necessarily rough estimates at this early date and the figures given are made somewhat conservative to allow for increases over last year in visible and invisible stocks and for unfavourable economic conditions in some countries. Thus, the increase in world consumption in 1922 over 1921 was more than 16 per cent.; the estimated increase in 1923 over 1922 is only 2 per cent.

[1] This is carry over from one crop to another, and not stocks on any given date.

The following table shows the pre-war and 1922 sugar consumption of the principal countries of the world, with estimates for 1923:—

PRE-WAR, 1922, AND 1923 CONSUMPTION OF IMPORTANT SUGAR-CONSUMING COUNTRIES, IN LONG TONS OF RAW SUGAR.

Countries.	Pre-war average, 1912-1914.	1922.[1]	1923 estimates.[1]
United States	3,800,000	5,461,000	5,600,000
Canada	290,000	388,000	400,000
Mexico	125,000	110,000	120,000
Argentina	210,000	225,000	225,000
Brazil	320,000	360,000	380,000
Austria	700,000	110,000	120,000
Hungary		72,000	75,000
Czechoslovakia		309,000	300,000
Belgium	200,000	158,000	170,000
Denmark	106,000	150,000	155,000
France	705,000	806,000	850,000
Germany	1,500,000	1,460,000	1,400,000
Italy	175,000	300,000	315,000
Netherlands	125,000	235,000	220,000
Norway	50,000	85,000	85,000
Poland	[2]100,000	150,000	180,000
Spain	127,000	176,000	180,000
Sweden	152,000	180,000	180,000
Switzerland	120,000	130,000	130,000
United Kingdom	1,900,000	1,725,000	1,750,000
Australia	250,000	280,000	300,000
British India	3,270,000	3,000,000	3,000,000
China	447,000	800,000	800,000
Japan	323,000	550,000	600,000
All other countries	2,505,000	1,460,000	1,600,000
Total	17,500,000	18,680,000	19,035,000

European consumption of sugar in the pre-war years averaged about the same as its production. Both declined during and after the war period and both have greatly increased from 1920-21 to the present time. But while the consumption did not decline so sharply as the production, it has recovered to an even greater extent in the last two years and has reached the pre-war total (exclusive of Russia).

From the data now available it looks as if 1923 would see a decrease in Europe's import needs amounting to 350,000 to 400,000 tons; but the United States supplies will have to be supplemented by about the same amount in order to make up for the decrease in the domestic beet and cane crops. The total European sugar production, consumption, and import needs in 1922 and estimates for 1923 are shown in the following table, together with the 1922 shipments to Europe from Cuba, Java, and the United States:—

EUROPEAN SUGAR PRODUCTION, CONSUMPTION, AND IMPORT NEEDS.

Years.	Consumption.	Production	Import Needs.	Exports to Europe from— Cuba.	Java.	United States.
	1000 tons.	*1000 tons.*	*1000 tons.*	*1000 tons.*	*1000 tons.*	*1000 tons.*
1921-22	6378	4037	2341	856	370	854
1922-23	6581	4615	1966	—	—	—

[Report (abridged) of E. G. MONTGOMERY, Foodstuffs Division, Washington.]

[1] 1921-1922 and 1922-23 sugar years for the Continent of Europe.

[2] Former Russian Poland only; the consumption of former Austrian and German Poland is included in the figures for Austria-Hungary and Germany.

Norwegian Market for American Sugar.

Norway imports annually about 60,000 tons of sugar, practically one-third of which amount is entered at the port of Bergen, as many of the largest sugar importers in the country are located in that city. Before the war the greater part of this sugar came from Germany and was handled through export houses at Stettin. When that source of supply was suddenly cut off in 1914, a new purchasing market was sought, and during the war years most of the sugar consumed in Norway was bought in the United States, while smaller quantities came from the Netherlands. American exporters dominated the market practically up to the present year.

There are indications that the American exporter is losing the market which he held in Norway during war times, not only because the prices of his product are higher than those offered by European competitors, but also because the American exporter has failed to conform to local business customs and to local taste. In pre-war days, a German sugar tablet about one-third the size of the ordinary American sugar cube was popular in this market. The Czecho-Slovak and Polish sugar exporters have copied the German tablet and British exporters have also made a sugar cube which is also just one-third the size of the American cube. Most of the sugar now on sale in Bergen is from Czecho-Slovakia or Great Britain. A few weeks ago the first shipment of Polish sugar—about 1600 cases of 50 kilos (110 pounds) each—was received from Danzig, and it is said that large orders have been placed in Prague and Danzig for January and February deliveries.

The United States is still leading in the sales of granulated sugar in the Bergen market, but the dealers report that granulated sugar from the Netherlands is of as good quality and is cheaper. American sugar, however, is still preferred because of better packing. This sugar is sold in linen-lined bags weighing 100 lbs, while the Dutch granulated sugar and that from Czecho-Slovakia and Poland is sold in jute bags weighing 100 kilos (220 lbs). Belgian exporters offer a cheaper granulated sugar, which also finds a demand by the bakeries, fruit-juice factories, and similar industries. [Consular Report, December, 1922]

Sugar Situation in Austria.

The continuous autumn rains in Austria had an adverse effect on the sugar content of the beets, and although the crop of sugar this season is said to be a fairly good one, its quality is inferior to that of the last season. About 20,000 tons of sugar will be produced from the local harvest and this will cover domestic needs for about two months. On the whole Austria's consumption of sugar has dropped somewhat. The earlier lively market has limited itself more or less to the manufacturers of candies and liqueurs, and to the demands of those organizations which supply the labouring classes with foodstuffs. As Austria's domestic production can cover only local needs for two months, the Republic will have to import about 100,000 tons of sugar during the remainder of the year. Czecho-Slovakia is the chief source of supply for this commodity. Exports of sugar from Czecho-Slovakia to Austria in October and November, 1922, amounted to 17,000 tons, as compared with 5,000 tons in the corresponding months of 1921.

No changes have occurred in the official regulations governing commerce in sugar. The export of sugar is still forbidden and transit trade must secure an export permit. In September and October the transit trade was very lively but has now entirely ceased. The principal purchasers of sugar in transit were Hungarians. According to the new customs tariff, the import duties on sugar are six gold crowns per 100 kilos. At present the Government is discussing the advisability of increasing these duties to about 18 gold crowns per 100 kilos. and authorities intimate that a law to this effect will be passed by the end of the current year. [Consular Report, December, 1922.]

Cuba.

By far the most important industry in Cuba is the production and marketing of sugar and its by-products, which are molasses, rum, alcohol, etc., representing a total value of over $910,000,000 for the 1919–20 season and $405,000,000 for the season of 1920-21.

Next in importance comes the growing of tobacco and the manufacture of cigars and cigarettes. The average annual production of tobacco runs from 400,000 to 600,000 bales of from 100 to 120 lbs. each, a considerable portion of which is consumed locally. Other important products include fruits, vegetables, coffee, cattle, copper, iron, and manganese.

The sugar industry is the backbone of Cuban commerce, and the prosperity of the country is dependent on the successful marketing of this crop and its by-products. Anything that tends to interfere with the sugar industry at once affects practically every other industry and business in the island. The statistics published annually by the Cuban Government in the "Industria Azucarera y Sus Derivados" are of importance and interest, furnishing very complete figures showing production, exportation, and importation of sugar and its by-products, as well as importations of machinery and other articles required by the industry. Export and import figures are for fiscal years ending June 30 and production figures are for entire seasons. The values given in the case of production are based on those declared for exportation of the class of product concerned.

Articles	1919-20. Quantity.	1919-20. Value.	1920-21. Quantity.	1920-21. Value.
Production :		$		$
Sugar, long tons	3,758,347	886,106,314	3,974,116	389,448,766
Molasses, gallons	183,544,070	5,403,218	205,256,252	4,813,117
Brandy, do.	11,436,557	8,622,424	1,865,173	1,641,558
Alcohol, do.	11,993,152	10,090,162	9,663,947	9,720,081
Total	....	910,222,118	....	405,623,522
Exportation :				
Sugar—				
Raw, long tons	4,224,383	776,268,775	2,281,932	338,738,281
Refined, do.	11,339	2,781,178	1,251	315,855
Molasses, gallons	158,577,976	4,796,697	97,143,776	2,725,473
Confectionery, lbs.	1,313,543	193,690	875,346	143,312
Brandy, gallons	2,069,342	992,682	1,875,644	1,374,863
Alcohol, do.	1,008,309	739,871	1,684,061	1,415,867
Rum, do.	84,787	132,994	68,127	111,631
Other distilled products, gallons	86,842	59,316	9,230	8,626
Total	....	785,965,203	....	344,833,908
Importation :				
Sugar sacks, kilos	31,377,888	11,074,931	29,627,860	7,693,334
Sugar machinery, kilos	....	17,488,777	....	34,826,568
Sugar—				
Raw, lbs.	....	....	18,529	2,106
Refined, do.	46,835	9,504	5,053,909	517,637
Glucose, do.	1,600,610	93,261	1,725,905	100,598
Saccharin, do.	3,615	13,900	11,526	40,438
Alcohol, gallons	136	241	654	811
Total	....	28,680,614	....	43,181,492

Messrs. Robert Hudson, Ltd. of Leeds, have recently booked orders for Africa representing over one hundred thousand tons of British steel railway material, including rails, sleepers, points, crossings, and rolling stock. As is known, this firm specialize also in light railway equipment for sugar estates.

Publications Received.

The Pocket Guide for the West Indies. By Algernon Aspinall, C.M.G. New and Revised Edition. x + 480 pp.; 23 Illustrations and 15 Maps. (London: Sifton, Praed & Co., Ltd.). 1923. Price: 10s. net.

Since the last edition of this standard guide to the West Indies was published in 1914, a good deal has happened in the Caribbean area, the most notable events being the opening of the Panama Canal and the transfer of the Danish West Indies to the American flag; while Royal and political visitors have toured the area and served to awaken public interest in the welfare of those historic parts of the British Empire. As a consequence, Mr. ASPINALL has been led to re-write the Guide and re-arrange its subject matter; he has also provided it with an entirely new set of maps specially prepared for it by Mr. A. J. SIFTON, F.R.G.S. These maps are perhaps the only feature in the new volume as to which, personally, we are disposed to offer criticism. Possibly they are designed to give the tourist in clear bold type the positions of the chief leading centres of population and ignore all other geographical features. For ourselves we greatly prefer the old wine of the earlier edition; any one comparing the two maps of Cuba, for instance, would undoubtedly give the palm to that one provided the reader in 1914. However, maps apart, the new wine needs no bush, and we unhesitatingly recommend this work to all those who contemplate a visit to the West Indies or desire reliable information as to its past history and its present attractions.

Methoden van Berekening in de Suikerfabriek. By Dr. C. W. Schonebaum, 48 pages. (A. H. Kruyt, Amsterdam.) 1923.

It is explained in the preface that this small book has been compiled for the use of the students of the School voor Suikerindustrie in Amsterdam; and it is added that perhaps it may also be found serviceable by those already engaged in the industry. It sets forth a number of calculations relating to the composition of the factory products of the sugar industry, quotients or factors, beet and cane juice extraction in diffusion batteries and mills respectively, clarification, massecuite working, and white sugar manufacture, and the use of steam in the beet and cane factory, the fundamental principles underlying these methods of computation being quite clearly explained throughout. It is an excellent volume, so far as it goes; but the calculations which are exposed are for the greater part very elementary, and do not cover a sufficiently wide range. One or two books discussing very thoroughly the calculations requiring to be made by the technologist engaged in the beet sugar industry have already been published, and that by Dr. WOHRYZEK was recently reviewed in these columns[1]; but a similar book adapted to the use of the cane factory practician as an aid to his calculations, in regard to the milling installation and boiling-house, and particularly relating to the compilation of chemical control data in general, has yet to be written. It is hoped that Dr. SCHONEBAUM in the event of the publication of a future edition of his small work may see fit to extend it, so as to meet this wider requirement.

Starch and Starch Products. By Harold A. Auden, M.Sc., D.Sc., F.C.S. (Sir Isaac Pitman & Sons, Ltd., London, Toronto, and New York.) 1923. Price: 3s. net.

This small book belongs to Pitman's "Common Commodities and Industries" series, and gives a brief but fairly comprehensive outline of the nature, varieties, origin, and utilization of starch and its products. It has not been written specially for the chemist and technologist, but rather for readers requiring a general survey of the subject from a wide standpoint. It is well illustrated, clearly written; and gives a good deal of information of a diverse nature, historical, commercial, botanical, scientific and technical. Thus, there is an historical chapter, telling us of the great antiquity of the use of starch; another dealing with the properties of starches; while subsequent sections treat of potato, cereal, maize and millet,

[1] *I.S.J.*, 1921, 694.

rice, sago, arrowroot, cassava, tapioca and other starches, their origin, properties, and preparation, and uses. Then there are chapters on glucose, dextrin, and "gum," and the use of starch products for the manufacture of alcohol. This is a well-written small treatise, which well maintains the standard set by other members of the "Common Commodities and Industries" series. It may be confidently recommended as a reliable little manual to the general reader, the business man, and the operator, interested in the starch industry.

Chemical Reactions and their Equations. By Ingo W. D. Hackh, Ph.C., A.B. (Chapman & Hall, Ltd., London.) 1922. Price: 6s. net.

Inability to balance an equation is a very common difficulty of students of chemistry, even molecular equations, while many will be met who are unable to balance a complete ionic equation, one, for example, involving reduction and oxidation. This small book, which has been written to rectify such a shortcoming, expounds elementary principles such as those relating to nomenclature of compounds, valency, valence numbers, ionization, and gives numerous problems and calculations for practice in their application. Furthermore, there is a chapter on reactions and their control by surface subdivision, catalysts, concentration, pressure, heat, and electrical means; and one on the types of chemical reactions, these being stated as: addition; decomposition; metathesis; neutralization; hydrolysis; combination; division; displacement; substitution; and restitution. Generally in textbooks on inorganic chemistry written for the use of the young student the balancing of purely chemical equations is not given much space. This small book, however, states the general principles of the subject at sufficient length and with sufficient clearness, and moreover provides the necessary material for application to a wide variety of reactions. It should, therefore, fill a want; and there is little doubt that it will be well received.

House Rats and Mice. David E. Lantz. Farmers' Bulletin, 896. U.S. Department of Agriculture, Washington, D.C., U.S.A.

It is pointed out in this practical contribution that the most direct method of dealing with the problem of rat repression is to deny the pest both food and hiding places. Accordingly, advice is given on the construction of rat-proof buildings, and insistence is made on greater cleanliness about warehouses, markets, stables, farms, and residences. In addition, schemes are drawn up for the systematic destruction of the rat by: (*a*) trapping; (*b*) poisoning; and (*c*) organized hunts.

The Microscope. By Conrad Beck. First Edition. (R. & J. Beck, Ltd., 68, Cornhill, London.) 1921. Price: 2s. 6d. net.

This is a guide to the use of the microscope. Seeing that the correct use of the instrument follows directly from a knowledge of the functions of the different parts, it has been found best by the writer to develop the method of manipulation in the course of the descriptions of the component parts. Such particulars as are given of the principles of its optical construction are of the simplest character, and their comprehension requires no optical knowledge. This small book forms an excellent introduction to the interesting study of microscopy; and, though in general of an elementary character, yet it contains a good deal of useful practical matter which is not available in the ordinary textbooks on the subject.

Heat Transmission (in Cooling Liquids). Technical Records of the Explosives Supply, No. 9. 1915-18. Department of Scientific and Industrial Research. (H.M. Stationery Office, Kingsway, London.) Price: 5s. 3½d., post free.

Discusses the theoretical aspect of the subject, and gives the experimental results of investigations carried out during the war regarding the most suitable type of coolers used in various explosives factories. A number of alignment charts are reproduced.

Review of Current Technical Literature.[1]

MANUFACTURE OF PLANTATION WHITE SUGAR, USING SULPHITATION AND BACH'S PROCESS. *Charles Saillard. Journal des Fabricants de Sucre de France, No. 2, 13 Janvier, 1923.*

When in 1910 the author was manager of a large factory in Bolivia, he put into operation a process of making white sugar of such a quality that its production had the effect of expelling from the market of that country the German refined which was being imported at the time, the various steps being as follows: Raw mill juice was limed to a very distinct alkalinity to phenolphthalein; sulphited strongly (the sulphur burnt being between 300 and 400 grms. per 1000 litres of juice treated); treated with lime sufficient to impart an alkalinity to litmus, but not to phenolphthalein; heated to 85° C.; subsided in well-lagged settling tanks; concentrated in a quadruple effect; syrup at 16–18° Bé. withdrawn from the second body, limed, phosphated, subsided, and returned to the third body of the effect; and the syrup finally evaporated to about 30° Bé. and boiled to grain in the pans with the addition of sodium hydrosulphite. This process, though it did not necessitate filtration, made it possible to obtain the whole production of the factory as a good white product, in spite of the fact that all the time burnt cane was being crushed. But it had inconveniences, such as the necessity for close supervision, owing to clarification being applied at two stages; the evolution of sulphur dioxide in the evaporators, owing to the decomposition of unneutralized bisulphites; and the large number of decanting tanks required. Turning to discuss the best conditions of working in Guadeloupe, the author remarks that, though the results given by the process just described were on the whole certain and satisfactory, yet he would not recommend it, unless the particular factory concerned happened to possess a large tank capacity, capable of being transformed into subsiders without much expense. Nor would he recommend carbonatation, at least for factories with an attached distillery, since this would involve a certain destruction of "glucose"; but the process which he would prefer above any is Bach's, which is applied at the syrup stage. Syrup from the evaporators (resulting from juice treated with lime to neutrality or slight acidity in the usual way) is cooled to 40–45° C., after which it is limed and sulphited simultaneously, the action of an excess of lime on the reducing sugars being thus avoided, while an energetic clarifying effect is nevertheless obtained. This operation is terminated when all the lime necessary has been added (using perhaps 2 kg. of CaO on the syrup resulting from 1000 litres of juice), and the SO_2 is shut off when the syrup is neutral to phenolphthalein, but hardly alkaline to litmus paper. It is re-heated to 90–95° C., and sent through filter-presses, which filtration takes place easily (provided that the amount of lime used has been sufficient), giving a light and brilliant syrup. Regarding the scums obtained, these may be washed with water condensed in the evaporators, or preferably mixed with the defecation scums, and the whole filter-pressed. Of this method of working, it is remarked that the apparatus required is simple, the control is easy, while the first sugar made is a beautiful white product.

MILLING VALUE OF CANE LEFT STANDING DURING TWO YEARS. *Wm. E. Cross and S. Delascio. La. Planter, 1922, 69, No. 5, 74–76.*

In 1919 the yield of cane in Tucuman was so great that it was impossible to grind it all before the rainy season; and thus the problem arose whether to burn the crop (and incur the cost of cutting and carting it, and that of cultivating and irrigating the next harvest), or whether to leave it standing until the following season. On the one hand the former method ensured a crop of new cane acceptable to the factory; while on the other the second meant that no cultivation costs would be incurred, and further that the tonnage would be considerably larger. Bearing in mind that in other countries, it is quite the custom to leave cane standing over until the next season, and also that this had actually been done at the Tucuman Experiment Station on a small scale with a satisfactory result in respect of sweetness and fibre content, the decision was made in favour of the second

course. At the same time, the opportunity was taken to obtain more precise data than at present exists on the behaviour of the purity, sucrose and fibre contents, during the second year's growth, so observations were made, not only in the planters' fields, but also at the Experiment Station, the varieties concerned being the POJ 36, 213, 234, 228, and the Kavangire (Uba), the first four being eighth and the last second ratoons. Samples of these various varieties were analysed at frequent intervals, making these always as representative as possible, and a good number of data was collected and tabulated. Summarizing their investigations at the Experiment Station, Dr. CROSS and his collaborator state that these results obtained in the subtropical zone of Tucuman demonstrate that the canes maintained their purity quite well during the whole of the second year without suffering more than a slight increase of glucose. On the other hand, their water content increased considerably during the rainy season, but decreased again partially during the autumn. During this second year, the various varieties showed a fair development, but by no means as rapid a one as the new cane which was planted for the sake of comparison at the beginning of the second year. Most of it continued growing in a normal manner without throwing out side shoots, though a small proportion produced one or more of such side shoots, which in some cases grew to quite a large size. By reason of the exceptional length of the stalks, the cane became very twisted, and in many cases partially fallen, and further a quantity of new cane produced by sproutings from the stubbles also appeared, this together with the old twisted and fallen cane giving the fields the aspect of a tropical jungle. Analyses made of the canes throwing out side shoots indicated that these were not of that low purity popularly attributed to them, the results showing up reasonably well in comparison with the other canes. A further fact noticed was that the fibre content of the canes as a whole increased considerably during the second year, though by no means to an extent such as would make milling economical. Regarding the results obtained with the planters' canes, though the sucrose content was in general much higher, the same general observations just started were found to hold good. From the field point of view, the old cane was somewhat difficult to harvest, being of such thick growth, and so twisted and fallen and provided with off-shoots, and thus cost more per ton to cut. In fact it was difficult to get the labourers to cut it, even at the higher prices offered. In milling the second year cane, the extraction was low as the result of the high fibre, though it may be added that neither in the process of clarification, nor at the later stages, did the juice present any difficulties.

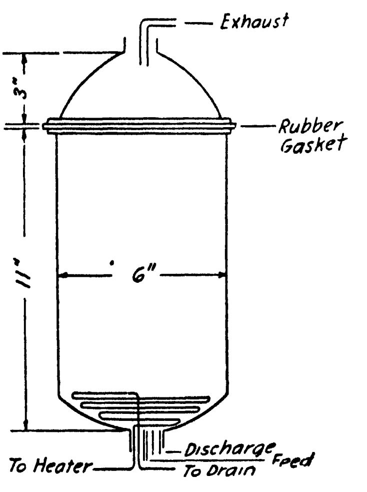
PLANTER'S PAYMENT OF CANE, THE COST OF MANUFACTURE, AND THE PROFITS OF MANUFACTURE OF SUGAR IN MAURITIUS. *E. Haddon. La Revue Agricole de l'Ile Maurice, 1922, 1, No. 4, 188-189.*

So long as the average sucrose content of the cane was 13·5 per cent., the extraction 75 per cent., the cost of manufacture 3 rupees per 100 kilos of sugar, and the selling price of the sugar Rs. 15·34, the *usiniers* of Mauritius in the days before the war were content to give the planter 70 kg. of sugar per ton of cane delivered; and under these conditions the profit of the manufacturer was Rs. 1·72 per 100 kg. of sugar, namely, 101·25 — 70·0 = 31 kg. at Rs. 15·34 = Rs., 4·75, *minus* Rs. 3·03 the cost of manufacture at Rs. 3 per 100 kg. Conditions, however, have now altered. Last year after the heavy rains the content of sucrose in the cane was only 11 per cent.; and therefore as the cost of manufacture has more than doubled (and in some cases has sextupled), and the net selling price of the sugar is now about Rs. 23·60 per 100 kg., it means that the manufacturer may suffer a loss, viz., as much as Rs. 2·82 per 100 kg. of sugar made by him. As a measure for preventing this occurrence, the writer proposes to determine the sucrose content of each planter's cane, and to allow him two-thirds of the actual extraction obtained from that cane, which with an extraction of 75 per cent. would be equivalent to 50 per cent. of the sucrose in the cane. Thus with a cane content of 10 per cent., the planter would have 50 kg. of sugar per ton of cane; with one of 12 per cent. he would get 60 kg.; and with one of 15 per cent. 75 kg., and this scheme would at once compel the planter to deliver the best cane possible, and the *usinier* to operate to the best advantage. Assuming a sucrose

content in the cane of 14 per cent., an extraction of 75 per cent.; a cost of manufacture of Rs. 7 per 100 kg.; and a selling price of Rs. 23·90, then the planter would have his 70 kg. of sugar as payment for his cane, and the manufacturer would have Rs. 0·91 per 100 kg. of sugar as his profit. But if the manufacturer were to improve his installation, and thus realize an extraction of 80 per cent., in place of the 75 per cent. formerly obtained, then, while the planter would still get 70 kg. of sugar, the *usinier* on the other hand would get Rs. 2·07 per 100 kg. of sugar as his profit.

A LABORATORY VACUUM PAN. *J. F. Brewster. Journal of Industrial and Engineering Chemistry, 1923, 15, No. 2, 139.*

Full particulars are now available regard the serviceable laboratory vacuum pan devised by the writer, some details of which have already been published.[1] Often the chemist requiring to conduct evaporations *in vacuo* uses two round flasks, one heated externally serving as the pan, and the other cooled by running water serving as the condenser, but this arrangement is somewhat clumsy and evaporates slowly. Much better results are obtained by means of the pan shown in the sketch, the body of which consists of an inverted bell jar 6 in. in diam., with ground flange and wide mouth; this is supported by an asbestos ring resting on a tripod. The mouth of the body is closed by a rubber stopper, through which pass the feed and draw-off tubes of glass and the leads of the flat-wound heating coil of $\frac{3}{16}$ in. copper tubing. When the spiral coil is wound, the ends of the tubing are brought close to the centre and bent at right angles to the spiral plane, being left long enough to pass through the rubber stopper and to provide for connexion, one to the drain, the other to the source of heat. The top of the pan is the glass dome of the ordinary vacuum distilling apparatus shown in the catalogues of dealers in laboratory apparatus. This is fitted to the body by means of a rubber gasket. A second bell jar or the tubulated top of a vacuum desiccator may very well serve as the dome of the pan. The rubber stopper closing the mouth of the dome carries the thermometer and the glass exhaust tube leading to the condenser. The pan coil may be connected by means of brass unions or rubber tubing to the coil of a Fletcher instantaneous water heater. With a good working pump a vacuum of 27–28 in. of mercury may be maintained; consequently it is unnecessary for the pan coil to be brought to a very high temperature and the Fletcher heater may be replaced by a helix of copper tubing heated by a Bunsen flame. The temperature of the water entering the coil may be controlled by varying water or gas pressure. Several types of condenser are suitable for vacuum distillation. The Soxhlet ball condenser is small and efficient, or a closely wound helix of block tin or copper tubing $\frac{1}{4}$ in. in diam. with water-jacket may be used. The latter is supported in a vertical position and discharges into a filtering flask. If a mechanical pump is at hand, the distillation may be made continuous by withdrawing the condensate when necessary. The parts may readily be duplicated since they are stock materials carried by laboratory supply houses. With interior heating, distillations under reduced pressure may be accomplished with a great saving of time over that required with externally heated apparatus, owing to the large heating surface and the heat conductance of the coil. The boiling of cane syrup to massecuite with this apparatus requires one-third or less time than with the flask and water-bath arrangement. It has also proved very satisfactory for reducing the volume of alcoholic plant extracts.



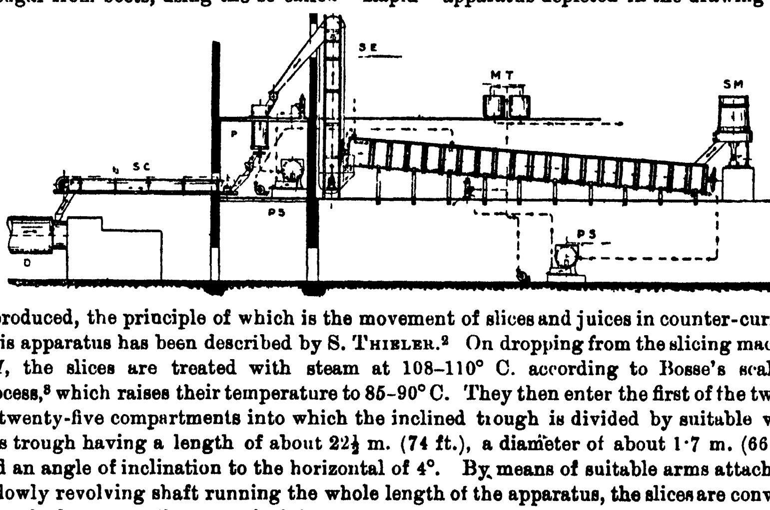
[1] *I.S.J.*, 1922, 535.

MANUFACTURE OF INDUSTRIAL ALCOHOL AND ALCOHOL MOTOR FUEL IN THE PHILIPPINE ISLANDS. *Howard I. Cole.* *Philippine Journal of Science, 1922, 21, No. 1, 17-46.*

Though having particular reference to Philippine conditions, this is a very useful statement on the production of alcohol motor fuel in general, the following being the principal points discussed: raw materials for the production of alcohol; yield of alcohol from various materials and by various processes of fermentation; alcohol and its mixtures as fuels for internal combustion engines; manufacture of alcohol-ether motor fuels; cost of the plant necessary; and the cost of production [1] It is said that the Natalite Co., of South Africa, in 1920, showed a profit of 38 per cent. of its capital, and that the original £5 shares are now quoted at £105. "Utilization of waste molasses, and of the unlimited supply of nipa sap in the production of alcohol motor fuel would not only make the Philippine Islands independent of other countries for its supply of motor fuel, but would also constitute a very valuable addition to the industries of the Islands. Since modern industry largely depends on an abundant and cheap supply of motor fuel, and since in time of war the price of imported fuel goes skyward and the supply is curtailed, the establishment of an industry supplying motor fuel from the natural resources of the Archipelago will be of immense value to the Philippine Islands." A fairly complete bibliography is appended.

"RAPID" PROCESS FOR THE EXTRACTION OF JUICE FROM THE BEET. *V. Sazavsky.* *Zeitsch. Zuckerind. cechoslov Republik, 1923, 47, (iv), No. 17, 249-255.*

During the war attempts were made to evolve a continuous method for the extraction of sugar from beets, using the so-called "Rapid" apparatus depicted in the drawing here



reproduced, the principle of which is the movement of slices and juices in counter-current. This apparatus has been described by S. THIELER.[2] On dropping from the slicing machine *SM*, the slices are treated with steam at 108–110° C. according to Bosse's scalding process,[3] which raises their temperature to 85-90° C. They then enter the first of the twenty or twenty-five compartments into which the inclined trough is divided by suitable walls, this trough having a length of about 22½ m. (74 ft.), a diameter of about 1·7 m. (66 in.), and an angle of inclination to the horizontal of 4°. By means of suitable arms attached to a slowly revolving shaft running the whole length of the apparatus, the slices are conveyed from the bottom to the top end of the trough over the dividing wall of each compartment. Water at 55–60° C. enters at the top end, flowing in counter-current to the slices from compartment to compartment through perforations in the dividing walls, and leaving the lower end of the trough in the form of juice. When the slices arrive at the top, they are raised by an elevator *SE*, and dropped while still hot into the pulp-presses *P*, the resulting residue being sent by means of the conveyor *SC* to the pulp dryer *D*, while the expressed juice is returned by way of a pulp separator *PS* to the trough at its fifteenth compartment. Lastly, it is pumped to the measuring tanks *MT*, and passed to the clarifying department. A favourable report has been published by S. THIELER[4] regarding this so-called "Rapid" process of beet extraction, though criticisms of it have also been

[1] The figures for the cost of the plant, and for the cost of the operation of the plant, are those which were recently reproduced in these columns. See *I.S.J.*, 1922, 436.

[2] *Centr. Zuckerind.*, 1920, 28, 492. [3] *German Patent*, 244,260; *U.S. Patent*, 1,005,931. [4] *Loc. cit.*

passed by E. SAILLARD[1] and H. CLAASSEN[2]; and now the author of this paper (who was entrusted with the compilation of the control data during the trial at the Buk, Hungary, factory) frankly expresses his opinion of it. A test running for 10 hours was carried out, and showed the following results: sucrose content of the roots worked, 16·85 per cent.; roots worked, 1303·54 quintals; sucrose content of the exhausted slices, 0·94 per cent.; quantity of exhausted slices obtained, 529·0 q.; density of the juice, 13·29° Brix; sucrose content of the juice, 11·79 per cent.; apparent purity of the juice, 88·8°; dry substance of the exhausted slices, 12·03 per cent., juice drawn off, 1750 hectolitres; determined losses 0·38 per cent., draw-off, 140 per cent. by weight; and capacity of the apparatus (which had 23 chambers), 3128 q. in 24 hours. These average figures appear not unfavourable; but do not convey a true impression of the value of the process; because, though claimed to be a continuous one, operation for a longer period than 10 hours was impossible. It has been stated that the invention provides a means of effecting an efficient counter-current operation, the slices moving in one direction, and the juice in the opposite one; but in the Buk trial this was not so. Some of the slices were moved forward more readily than the rest introduced at the same time, the consequence of this being that dense juice came into contact with slices containing a lower sucrose content. Another great defect of the working of the plant was the unusually great amount of fine pulp which passed out with the juice drawn off, with which the Babrowski separator, under ordinary conditions an excellent apparatus, was incapable of dealing. Summarizing the results obtained, and comparing the operation of the "Rapid" method with that of ordinary diffusion, it is stated the advantages are that economy in the use of water was effected; that there were no waste waters produced; and that during the 10 hours' run working was continuous. On the other hand, certain disadvantages (some of them serious) were apparent, namely that from the mechanical point of view operation was defective, and the apparatus unsuitable for continuous working (as claimed); that a considerable expenditure of mechanical power and heat was required; that the juice was thin, so that in the evaporators about 30 per cent. more water than in diffusion had to be eliminated; that the juice contained a quantity of fine pulp incapable of being separated in any known apparatus; and that finally the operation of the plant could not be controlled, the draw-off varying between 130 and 150 per cent., and the sugar content of the exhausted slices between 0·8 and 4 per cent.

DETERMINATION OF WATER IN SUGAR AND OTHER PRODUCTS BY MEANS OF CALCIUM CARBIDE. *T. Bonwetsch. Zeitsch. Zuckerind. cechoslov. Republik, 1922, 47 (iv), No. 5, 59.*

According to this writer,[3] calcium carbide affords a method for the rapid determination of water in sugar factory and similar products, and can be used in two ways. In the first the assay product is mixed in a definite proportion with calcium carbide (both being in the form of a fine powder), and according to the rise in temperature produced the amount of water can be almost immediately ascertained within a reasonable limit of accuracy. For example, by mixing 3 grms. of a product in fine powder (such as starch) containing 15 per cent. of water with 2 grms. of calcium carbide, the temperature was observed to rise to 60°C., and utilizing this principle a table of temperatures and water percentages for similar mixings may be easily constructed. In the second procedure, the volume of acetylene gas developed as the result of the reaction between the water and the carbide may be measured in a suitable apparatus, and the result determined in a very few minutes from a table of volumes and percentages previously constructed by working with material of known water content. It is suggested that in the case of the measurement of the evolved C_2H_2 this method may indeed give more reliable results than the ordinary one of drying on sand or paper when working with very low-grade sugar factory products, which are known to evolve not inappreciable amounts of volatile substances other than water during the operation of desiccation, thus giving a result higher than the truth.

J. P. O.

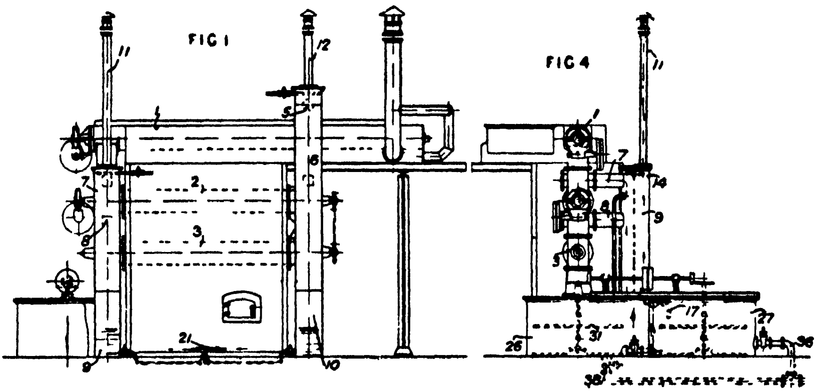
[1] *Circ. Hebdom.*, 1920, 245. [2] *Centr. Zuckerind.*, 1920, 28, 565.
[3] In his publication: "Der Zucker in Russland und im Auslande," Moskow, pp. 95-172.

Review of Recent Patents.[1]

UNITED KINGDOM.

REVIVIFICATION OF DECOLORIZING CARBON. *Naamlooze Venootschap Algemeine Norit Maatschappij (General Norit Co., Ltd.)*, of 2, Den Texstraat, Amsterdam. *188,672; addition to 104,456.* November 13th, 1922; convention date, November 14th, 1921.

An apparatus for revivifying finely divided decolorizing carbon, as described in the Specification,[2] is modified by forming the condensation and dust-collecting apparatus of a plurality of units, each connected to the heating cylinders by short and wide conduits to prevent choking by accumulation of dust and to facilitate cleaning. The apparatus, which may also be used for revivifying kieselguhr or fuller's earth, comprises a pre-drying



trough *1*, an upper retort *2*, and a lower retort *3* through which the material is continuously moved by screw conveyors and from which the gases, etc., evolved pass through wide tubes *5–8* to condensers *9*, *10*, each having a partition to ensure sinuous flow and partially filled with water, uncondensed gases escaping into chimneys *11*, *12*. Water or steam may be injected through atomizers *14* into the condensers to prevent solid particles from clogging together, and the sludge from the bottom of the condensers is discharged by an injector or pump *21*, the more liquid portion overflowing by pipes such as *17* into tank *26* or *27* having mixing arms *31* to prevent settling of the solids in suspension in the liquid which may be emptied through outlets *36*, *38*.

PRODUCTION OF AN ALCOHOL-ETHER FUEL. *H. Wade (F. E. Lichtenthaeler*, of Boston, U.S.A.). *187,051; 187,052.* July 27th, 1921.

Alcohol-ether mixtures, suitable for use as motor fuels, are produced by generating ether vapour, preferably from alcohol, and condensing it by absorption in alcohol. Alcohol is treated with sulphuric acid in a generator, and the ether vapours are neutralized and concentrated in a scrubber and a fractionating column fitted with a reflex condenser. Then the vapours enter a condenser, where partial condensation occurs, even when only warm condensing water (say 80–85°F.) is available, the uncondensed vapours being led into a tower, where they are absorbed in water-cooled alcohol. The mixture from the tower is mixed with the liquid ether from the condenser. When the condensing water is sufficiently cold, preliminary partial condensation is omitted, and the ether vapour is directly condensed and absorbed in cooled alcohol.

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

[2] *I.S.J.*, 1917, 431

PRODUCTION OF ETHER FROM ALCOHOL. *H. Wade (F. E. Lichtenthaeler,* of Boston, U.S.A.). *187,347.* July 27th, 1921.

Apparatus for the manufacture of ether comprises a plurality of conduits through which alcohol vapours are caused to pass, each conduit having a series of intermediate chambers for the reception of sulphuric acid which flows counter-current-wise and to which the alcohol vapours are exposed as they pass through the conduits. The conduits are contained in a pressure chamber through which steam is passed in or to maintain them at the reaction temperature.

ALCOHOL MOTOR FUEL. *F. N. Nicholls,* of Carbis Bay, Cornwall, *and D. Brown,* of Glasgow, Scotland. *188,469.* September 22nd, 1921.

A liquid fuel is prepared by the fermentation and distillation of peat, with or without the addition of distillation products of colza oil. The peat is steeped in water and allowed to stand while a fungoid growth takes place, it is then kiln-dried, crushed and mashed in a mash-tun. The liquid extract is then fermented with yeast, etc, and distilled. The distillate may be used by itself or mixed with a product obtained by distilling colza oil at a pressure of eight atmospheres and a temperature of 600°F. (315°C.). The colza oil distillate may be replaced by a product obtained from the rape oil plant by steeping in water, distilling in a tar or like still at about six atmospheres, and redistilling at about 200–300°F. (93–149°C.).

PRODUCTION OF ALCOHOL MOTOR FUEL. *F. de M. Accioly,* of Sao Christavao, Rio de Janeiro, Brazil. *187,640.* April 20th, 1921.

Alcoholic liquids for use as fuels for internal-combustion engines, lamps, etc., are prepared by distillation of fermented saccharine juices or of alcohol in presence of enriching compounds. Saccharine juices from sugar cane, oranges, cashew, manioc, beetroot, or water melons, or solutions of molasses or raw sugar, are fermented by addition of a mixture of yeast, tannic acid, neutral potassium tartrate and sulphuric acid. A composition consisting of the liquid obtained by boiling orange peel in water, Stockholm, coal, or petroleum tar, sulphuric acid and naphthalene is added and the mixture is distilled. To the distillate is added a composition consisting of turpentine, ether, naphtha, animal, vegetable or mineral oils, hydrochloric acid, coal or petroleum tar and naphthalene, and the mixture is again distilled. If alcohol is used in place of the fermented juices, a second composition of coal or petroleum tar dissolved in sulphuric acid and mixed with alcohol is added prior to the first distillation. A plant comprising fermenting vessels, filters, heat-exchangers, mixing vessels, two stills and condensers is described.

PRODUCTION OF ALCOHOL MOTOR FUEL. *P. Loriette,* of Paris, France. *188,336.* November 3rd, 1922; convention date, November 3rd, 1921.

A homogeneous mixture of alcohol and benzol, petrol, or other usual liquid hydrocarbon fuel is obtained by dehydrating the alcohol before or after mixing, for example, by the addition of calcium, calcium carbide, or other substance that reacts with water and forms an insoluble product, or of an absorbent such as anhydrous lime, ferrous sulphate, or potassium carbonate, or by passing alcohol vapour through a column of dehydrating material as when the alcohol is manufactured.

PRODUCTION OF ABSOLUTE ALCOHOL. *E. Barbet et Fils et Cie.,* of Paris. *189,136.* November 15th, 1922; convention date, November 15th, 1921.

A continuous process for the production of absolute alcohol consists in mixing alcohol of 95–96° per cent., by volume, with powdered quicklime or other suitable dehydrating agent and distilling the greater part in a continuous still, collecting the alcohol, and continuously withdrawing the remaining liquid mixture, diluting it with water and delivering it to a rectifier where it is exhausted of its alcohol which is concentrated to 96° and again subjected to dehydration. Apparatus for carrying out these operations is described.

DISTILLING AND RECTIFYING PLANT. *E. Barbet et Fils et Cie.*, of Paris. *189,458.* November 21st, 1922 ; convention date, November 21st, 1921.

In a continuous apparatus for distilling and rectifying alcohol of the kind described in Specification 107,975 in which the vapours from a distilling column are used to heat the rectifying column and the purifying column, the distilling column is operated under a slightly increased pressure, the rectifying column under a reduced pressure, and the purifying column at atmospheric pressure.

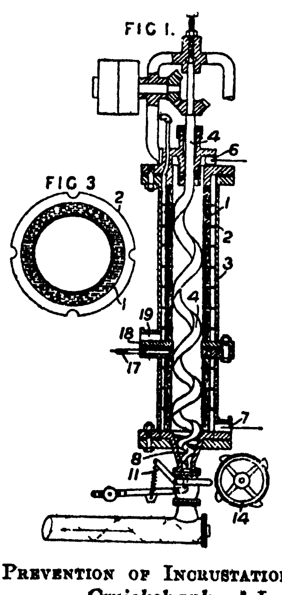
ROTARY VACUUM FILTER. *R. Timm*, of Dresden, Germany. *188,539.* November 18th, 1921.

Relates to vacuum filters of the rotary drum type having internal cells communicating with a common chamber located at one end of the drum, and provided with scrapers for the removal of residue clinging to the outer drum surface.

PREPARATION OF DECOLORIZING CARBON. *A. M. Hart*, of West Hampstead, London. *188,807* August 24th, 1921.

Peat, lignite, sawdust, or other carbonaceous material, is preliminarily treated with a potassium or sodium salt such as carbonate, chloride, sulphate, acetate or phosphate, either by wetting the material with a solution of the salt, or if already wet by intimately mixing with the salt dissolved in the least possible amount of water, and is then carbonized by roasting the mass on a hot plate while freely exposed to the air. According to an example, sodium carbonate or soda crystals are employed. To obtain a pure carbon, the product is boiled with dilute hydrochloric acid and dried. The carbon produced may be worked up into briquettes for fuel by use of a binder such as gluten, molasses, or casein treated with formaldehyde.

COLLOID FILTER. *Plauson's (Parent Co.) Ltd.*, of Pall Mall, London, S.W. (communicated by *Hermann Plauson*, of Hamburg, Germany.) *188,362.* July 7th, 1921.



In a continuous filter of the type described in specification 155,834,[1] the worm *4* is surrounded by a cylindrical filter element built up of superimposed annular members *1* separated by reinforcing plates *2* which project inwardly beyond the surface of the annular filter members. The filter-cake may be washed by supplying water to the worm, which would in this case be made hollow and furnished with outlet orifices; or alternatively, one or more hollow annular flanges *18* with water-inlet pipes *17* may be employed. The unfiltered material is supplied through a pipe *6* at the top of the apparatus, the filtrate and wash-liquor are led away by a pipe *7* at the base of the outer casing *3*, or the filtrate may be removed separately by a pipe *19* above the washing device. The solid matter escapes through a cone *8*, at the bottom of the press, which is periodically opened by a cam-wheel *14* to an extent depending on the pressure of the filter-cake, the amount of opening being controlled by a spring *11*. Brushes may be attached spirally to the upper part of the worm spindle.

PREVENTION OF INCRUSTATION AND CORROSION IN EVAPORATORS, BOILERS, &c. *V. H. Cruickshank*, of Loughton, Essex. *188,957.* November 21st, 1921.

In electrical systems for the prevention of incrustation and corrosion in steam-generators and the like, thin plates or shields of non-conducting material are provided at the connexion of the anode supports to the boiler shell, which acts as the cathode.

[1] *I.S.J.*, 1921, 594; 1921, 680.

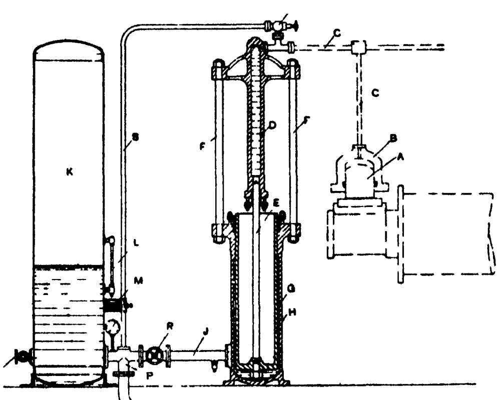
EVAPORATION OF JUICE BY DIRECT CONTACT WITH HEATED AIR. *C. Fraisse*, of Vaucluse, France. *189,772.* November 16th, 1922; convention date, November 5th, 1921.

ALCOHOL MOTOR FUEL. *Ricard, Allenet & Cie.*, of Melle, France. *191,000.* October 13th, 1922; convention date, December 28th, 1921.

A homogeneous mixture of alcohol and petrol, with or without other fuel substances such as benzol, is obtained by the addition of normal butyl alcohol. Thus a mixture of 4·75 volumes of butyl alcohol with 100 volumes of petrol (sp. gr. 0·729) dissolves in all proportions in a mixture of equal parts of alcohol and benzol, and 100 volumes of petrol mixed with 6·5 volumes of butyl alcohol is soluble in all proportions in alcohol. A mixture of 100 volumes of petrol, 12 volumes of alcohol, and 10 volumes of benzol requires 2·4 volumes of butyl alcohol to render it homogeneous at 0°C., 3·5 volumes at 13°C., and 4·75 volumes at —0·5°C.

HYDRAULIC PRESSURE REGULATING APPARATUS FOR CANE MILLS. *Duncan Stewart & Co., Ltd., Thomas Wishart, and William Kilpatrick*, all of Glasgow. *190,917.* December 28th, 1921. (One figure; two claims.)

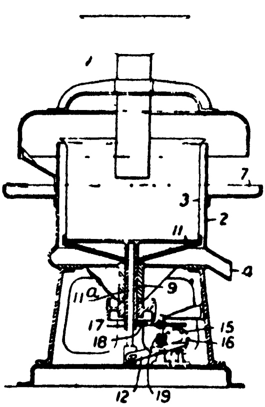
The apparatus to which the invention relates is of the kind in which there is an intensifier, that is to say two interconnected rams, one of relatively small and the other of relatively great diameter operating in two cylinders. High pressure liquid from the cylinder of the ram of lesser diameter serves the roll-controlling rams. According to the invention, low pressure liquid is supplied to the cylinder of the ram of greater diameter from a receiver in part filled with liquid and in part filled with air under pressure. The receiver is preferably provided with a pressure-relief valve, and means are provided for charging it with liquid and air and also for filling the remainder of the system with liquid. An example of the carrying out of the invention is illustrated in sectional elevation in the accompanying drawing. In this example the roll-controlling ram *A* in its cylinder *B* (of these, of course, several) is served by a pipe *C* from the cylinder *D* of the lesser diameter ram *E*, which cylinder has formed on it a crosshead by which it is supported by the rods *F* from a like crosshead on the cylinder *G* of the greater diameter ram *H*, which ram is in the form of a trunk piston. The greater cylinder *G* is served by a pipe *J* from the lower end of a receiver *K* in which a level of liquid (indicated by a gauge *L*) is maintained. Above this level is air under pressure. A relief valve *M* and a discharge valve *N* are provided on the receiver, while in the pipe *J* is a connexion *P* for the supply of liquid and air or other to the receiver. There is also provided in the pipe *J* an isolating valve *R*, while connexion between that pipe *J* and the pipe *C* is made by a pipe *S* controlled by a valve *T*. The pressures available are of course inversely proportional to the areas of the rams *E* and *H*, and thus comparatively high pressure upon the rolls is attained with a comparatively low pressure in the receiver. The ram *H* is of such length that its rise is limited by the crosshead of the cylinder *D*, and thus no liquid is lost if a breakdown occurs at the rolls excepting between the cylinder *D* and the ram *E* and leakage there may be made up on manipulation of the valves *R*, *T*, by way of the pipe *S*. Thus, loss of liquid from the receiver is exceedingly slight and may be made up in any convenient manner, while loss of pressure therein may be compensated by the admission of pressure air.



MANUFACTURE OF DECOLORIZING CARBON. *Algemeene Norit Maatschappij (General Norit Co., Ltd.)*, of Den Texstraat, Amsterdam. *189,148.* November 20th, 1922; convention date, November 19th, 1921.

Decolorizing carbon is produced from carbonaceous material of vegetable, animal, or mineral origin, by dry distillation in presence of activating gases or other substances with or without a preliminary distillation together with inert or slightly active gases. The gases, which may be chlorine, volatile chlorides, air, steam, carbon dioxide or monoxide, flue or generator gases, or a mixture of these gases, are passed through the charge in a direction opposite to that of the charge itself. The other activating substances specified are calcium or magnesium carbonates and chlorides, slaked or unslaked lime or "liquids or gases." The raw materials such as wood-waste, peat, waste cellulose, lignite, briquetted coal, etc., is charged into a retort, preferably vertical or inclined, and the active gas, preferably at 100–600° C., is introduced at the other end. The temperature of the retort is controlled by means of the gases, or by heating, so that it rises to a maximum and then decreases. Various temperatures are specified for the activation by the different gases. The retort gases produced are preferably removed at a short distance from one end of the retort, to obviate the choking of the conduit by the cooled products, and may be utilized to heat the retort. The product may be ground and purified by treatment with hydrochloric acid or "other chemicals."

CONTINUOUS CENTRIFUGAL MACHINE. *L. C. Harvey and C. A. M. Buckley*, of Streatham, London. *188,243.* December 16th, 1921.



A centrifugal drying machine has a perforated revolving cage *3* with a circular bottom plate *11* resting on a vertical shaft *11a*. The lower end of this shaft is connected by pin-and-slot connexion to one end of the pivoted lever *12*, the other end of which rests against a cam *15*. The driving spindle *9* is connected to the cam by toothed gearing *17, 18*, and worm gearing *19, 16*. The material is fed into the hopper *5*, falls into the cage *3*, and the moisture is thrown out to the casing *2* and nozzle *4*. At regular intervals, owing to the action of the cam *15*, the plate *11* rises and pushes the upper part of the material over the top of the cage into the tray *7*. The plate *11* then sinks and a fresh supply of material is introduced. The plate may be perforated and it may rotate with the cage. It may be arranged to close the shoot from the hopper *5* when it is in its raised position.

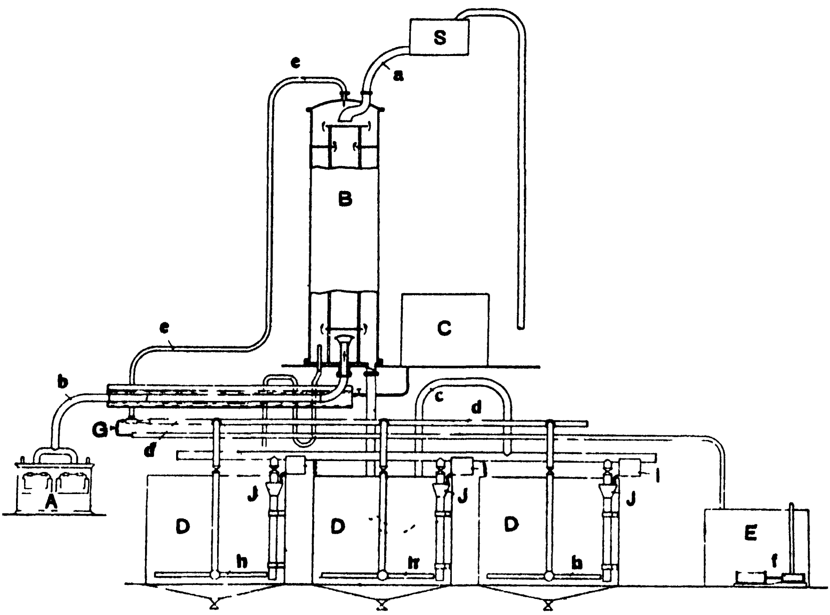
ALCOHOL MOTOR FUEL. *P. Loriette*, of Paris. *189,453*; addition to *188,336*. November 21st, 1922; convention date, November 21st, 1921.

Absolute alcohol is obtained by passing the vapours from, say, a dephlegmator through a succession of dehydrating agents of increasing effectiveness, for example, through lime and then metallic calcium or calcium carbide. Preferably each dehydrating agent is divided into two parts, the first of which is replaced when entirely used by the partly-used second portion, which is replaced by unused agents; and the vapours are heated prior to or during contact with the dehydrating agent to prevent condensation thereon. If carbide has been used, the alcohol, with its absorbed acetylene forms permanent homogeneous mixtures, suitable as motor spirit, with petrol, benzol, or other usual liquid hydrocarbon fuels as described in the parent specification.

FRANCE.

SULPHITATION APPARATUS, PERMITTING REGULATION OF THE OPERATION, AND OBVIATING LOSS OF SULPHUROUS GASES. *Even Budan.* *539,107.* August 6th, 1921. (One figure; two claims.)

A sulphitation apparatus for use in the cane or beet factory is described,[1] the originality of which consists in leading away the unabsorbed gases from the tower through which the juice falls, and forcing them by means of an injector (or other suitable means) through some of the juice contained in liming tanks, the whole arrangement of the plant permitting the regulation of the operation at will, while also avoiding loss of sulphurous gas by its escape into the atmosphere. Turning to the drawing, *A* is the sulphur oven, the gases from which are led through the pipe *b*, which is jacketted to allow of water cooling, then passed into the foot of the tower *B*, down which juice from the supply tank *S* is through the pipe *a* allowed to fall in the form of a series of cascades. At the top of the tower *B* is a pipe *e* connected with a compressed air or steam injector *G* for the purpose of withdrawing the unabsorbed gases and forcing them through the line *d* into one or other of the three



liming tanks *D*. These latter are provided with a conical bottom with an outlet, and two crossed perforated tubes *h*. At *f* is shown an air compressor, while *E* is the compressed air holder. Fixed to the side of each of the liming tanks *D* is a vertical tube *J*, provided with a funnel at its upper end, and through this tube the sulphited juice coming from the tower *B* is introduced, while the milk-of-lime from the box *I* is run into the funnel at the same time. The tube *J* reaches to the bottom of the tank *D*, in order to effect a good mixing, which is further ensured by the bubbling of the gases through the perforated tubes *H*. This construction permits one to regulate immediately the degree of sulphitation required, since the rate of burning the sulphur (and therefore the volume of sulphurous acid gas) is controlled by the injector *G*, which by being opened or closed increases or diminishes the vacuum in the tower *B*, and in consequence the amount of gas evolved by the furnace. Circulation pumps and mechanical stirrers are not required, and as the whole apparatus is worked under atmospheric pressure, escape of deleterious gas into the air is prevented.

[1] See also *I.S.J.*, 1922, 136.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922. Tons.
Total Receipts, January 1st to February 21st	424,224	..	569,267
Deliveries „ „	424,224	..	566,369
Meltings by Refiners „ „	387,870	..	472,188
Exports of Refined „ „	13,000	..	60,000
Importers' Stocks, February 21st	none	..	2,898
Total Stocks, February 21st	54,183	..	127,709
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1920 21 Tons.		1921-22 Tons		1922-23. Tons
Exports	67,210	..	70,932	..	387,680
Stocks	182,128	.	116,785		274,135
	249,338		187,717		661,815
Local Consumption	10,000	..	5,000	..	5,000
Receipts at Port to January 31st	259,338		192,717		666,815

Havana, January 31st, 1923 J. GUMA.—L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to January 11th, 1923.)

	Harvesting Period.	1922-23. Tons.	1921-22. Tons	1920-21. Tons.
Germany	Sept.-Jan...	1,600,000	1,305,810	1,152,960
Czecho-Slovakia	Sept.-Jan...	750,000	659,907	705,919
Hungary and Austria	Sept.-Jan...	94,500	91,220	47,644
France	Sept.-Jan...	560,000	278,273	305,041
Belgium	Sept -Jan...	295,000	289,866	242,589
Holland	Sept.-Jan...	285,000	376,000	317,196
Russia (Ukraine, Poland, etc.)	Sept.-Jan...	220,000	49,374	88,490
Poland	Sept.-Jan...	270,000	225,000	189,834
Sweden	Sept.-Jan...	63,000	227,000	164,194
Denmark	Sept.-Jan...	105,000	146,800	134,835
Italy	Sept.-Jan...	260,000	217,532	135,484
Spain	Sept.-Jan...	170,000	135,000	170,722
Switzerland	Sept.-Jan...	8,000	5,500	3,710
Bulgaria	Sept.-Jan...	25,000	22,000	7,837
Rumania	Sept.-Jan...	25,000	25,761	15,006
Total in Europe		4,730,500	4,055,043	3,681,461

THE

INTERNATIONAL SUGAR JOURNAL.

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Notes and Comments.

The Possibilities of Assam as a Sugar Producer.

We are glad to be able to publish in this issue a short account of the prospects of establishing an Indian sugar industry in Assam, written by a planter of such wide experience as Mr. J. T. J. Crooks; for it is eminently desirable that every effort should be made to extend the areas within the Empire devoted to successful sugar cane growing and cane sugar production, and to achieve that desideratum pioneer work of an experimental nature is necessary in a great many cases.

On the whole, we have always regarded Lower Assam as a much more favoured locality for sugar cane growing than any other tract in north India, because of its better rainfall and especially because of its more humid atmosphere. It is also free from the frosts which are so serious a limiting factor in the great north Indian sugar cane growing tract in the United Provinces and the Punjab, and the growing period is correspondingly of longer duration. The difficulties, which the author of the paper does not specify, are, we believe, chiefly connected with the flat nature of the country falling slightly to the river banks and the consequent danger of flooding, together with the great variations in the depth of soil, general absence of permanent communications, and the unpopulated nature of the country which makes it necessary for all labour to be imported. All of these will, as the author points out, necessitate a great deal of pioneer work in clearing, draining and road making, together with very careful cultivation, and we agree that such work will greatly help in diminishing the troublesome fever.

The chief new suggestions in the paper are those connected with the change of varieties of cane grown and the lengthening of the growing period. These are both of them valuable ideas and will call for very serious consideration on the part of prospective planters. We prefer not to form any definite opinion on them until the new varieties suggested by Mr. Crooks have had a trial, but hope that it will be found possible to complete the crop within the period of one year, as is universal in India. The author points out that the varieties at present grown cannot give a full crop because of the growing period only extending for about

eight months; this is certainly too short a time for the canes he mentions, but we would hope that such new varieties as he refers to would be found on experimental growth to mature within the twelve months, as much of the ripening of cane takes place when growth conditions are no longer possible. It is claimed that the new Coimbatore seedlings are markedly early maturing, and this will probably be the case with D 1135 and the thinner Java seedlings with north Indian blood in them. We doubt the advantage of introducing Uba as probably this cane has already been tried in Assam; it does not usually compare in India in richness of juice with that grown in Natal. It has already been suggested that the experiment should be tried of growing Uba in India over two years, as is done in Natal, to see if its juice may thus be improved. But the limiting factor in the latter country is the low rainfall more than anything else; according to our advices Natal has only half the rain in the year that Assam is favoured with, and it is difficult to institute comparisons on that account.

British Sugar Beet Growers' Society: Annual Report.

The Eighth Annual Meeting of the British Sugar Beet Growers' Society was held on the 11th of April, when the Committee submitted their Report of the work done since the last meeting took place. Most of it was concerned with influencing the Government last year to remit the Excise duty on home-grown sugar, an effort which was successfully accomplished.

As regards future plans, provisional arrangements have been made for the amalgamation of the two undertakings of Kelham and Cantley into a new company. The formation of this company is expected to take place on or before March 31st, 1924. Meanwhile, we gather that the Kelham factory has been leased to Mr. J. P. VAN ROSSUM, the principal owner and technical expert of the Cantley factory, for the present season and he has undertaken to find the working capital, as well as that for Cantley (all of which will be from Dutch sources), to take the whole responsibility of manufacturing sugar from the Kelham sugar beet crops at the Kelham factory, to supply the necessary technical personnel, and to take the responsibility for losses. The rent reserved under the lease is half the net manufacturing profits made, less interest on the new mortgage, and Home Grown Sugar, Ltd., will apply this rent to interest on the old mortgages and 5 per cent. on the share capital, any balance remaining to be used for the repayment of the new mortgage, which latter is a sum of £60,000 raised privately to improve and extend the Kelham factory.

The Financial Position of Kelham.

The financial position of the Kelham company, Home Grown Sugar Ltd., has lately come into prominence in the press. It is not surprising to learn that this over-capitalized concern has had to submit proposals for reducing its capital from £1,000,000 to £250,000, thus reducing the nominal amount of the shares in the company's capital from £1 to 5s. per share. At the meeting of shareholders at which the proposal was made, it was stated by the chairman (Sir ERNEST JARDINE, Bart.) that the writing down of the capital would put the company's affairs on a sound footing because in the pending balance sheet the assets would not appear at inflated figures and there would not be a debit balance to charge against future profits. It was added that the only alternative was to put the company into liquidation. There was a large majority in favour of accepting the Directors' recommendations, and a committee was appointed, drawn from the shareholders,

to confer with the board as to the future of the company and to draw up a report which is to be submitted at the next meeting of the company.

Undoubtedly the Kelham scheme has been in large part the victim of bad luck; it was started at the period of highest post-war prices for labour and materials, and at a time when the wheels of industry ran by no means smoothly. But undoubtedly too, as a shareholder suggested at the above meeting, the management cannot wholly absolve themselves from blame for some of the failure experienced. As far as we are concerned, we have never been satisfied that the wisest policy was invariably followed or the best advice sought in the task of bringing Kelham into material existence. As an instance, it does not appear that the directors ever issued adequate invitations for tenders for the factory and plant such as would have brought in quotations from far and near. They certainly placed advertisements in the English press inviting tenders for the machinery from English firms. Only one English company, we are told, sent in an estimate for the whole factory. The only other complete estimate, it seems, was from the Cie de Fives-Lille who ultimately got the order as their price was lower than the English quotation. But other countries besides France have well-equipped beet sugar industries, yet we have never heard that any opportunity was given, e.g., to American firms, to tender, nor was American beet sugar experience and practice to our knowledge invited to make suggestions or submit proposals for the construction of the factory. We see no reason to suppose that their price would have been markedly above that of the one accepted and it might conceivably have been lower. In many ways it would have been a good opportunity to try American beet sugar practice in a European setting, and American beet sugar experts are at least as competent as those of the European continent, especially where white sugar manufacture is concerned. However, the promoters decided otherwise, and it is a matter chiefly for the shareholders as to how far their policy was justified. We can only express the hope that now with the agreed reduction in the capital an unfortunate chapter in British beet sugar history is closed and that the early future will have something brighter in store for the industry.

Sugar Factory Renovations pending in Cuba.

According to *Sugar*, information has been received in New York that fifteen or more of the large sugar factories in Cuba which became financially embarrassed during the 1919-20 sugar depression are to be completely rehabilitated. It is understood that the National City Bank of New York is bringing out an issue of bonds of a total of $50,000,000 to cover the expense of bringing those properties' into a condition in which they will be able to compete for business on a reasonable production cost basis. Central Vertientes, Camaguey, is mentioned as the first to be modernized. These fifteen contracts will necessarily mean a large number of orders for sugar machinery and equipment, but whether the bank in question will buy in the cheapest market, or confine their orders to a few leading American sugar machinery houses, remains to be seen. In any event the lead given by these Cuban interests is likely to be followed by other concerns both in Cuba and elsewhere, so that it seems likely we are at length on the eve of a more or less general overhaul of the world's sugar manufacturing plants which in the majority of cases have been running for ten years with a minimum of alteration or renovation. The financial prospects of the current sugar crops are everywhere of a lucrative character, so that sugar machinery manufacturers can look forward with more confidence to better trade in the near future.

The American Sugar Refining Company.

The annual report of the American Sugar Refining Company for the year 1922 reveals a prosperous year, though the earnings over and above fixed charges, depreciation and the dividend on the preferred shares, have been devoted entirely to meeting the bad account losses on 1920 contracts developed during the year. The total business of the Company in all its departments amounted to $192,000,000, while the profits from operations were, after providing for taxation, $10,083,832. This represents 5¼ per cent. on total sales, or about 0·25 per cent. for each lb. of raw sugar melted. But while the balance of profit added to the surplus amounted to $5,404,787, the loss on 1920 contracts above referred to came to $5,358,145, so that the surplus balance at December 31st, 1921, was only increased by $46,642.

The report traces the course of the sugar market during the last two or three years. In 1920, it is pointed out, the United States consumer fearing a shortage bought from nearly 50 foreign countries a total of 885,868 tons of sugar and caused an over-supply which precipitated the distress of 1921, a year of misplaced tonnage, as Cuba was again displaced in the U. S. market by a considerable quantity of foreign sugar and finished the year with a surplus of 1,250,000 tons. But 1922 saw the start of a system of refining under toll for export which helped to equalize matters, and in the end that year saw a total of 819,964 tons of refined sugar (requiring 881,681 tons of Cuban raw sugar) exported to some 83 foreign countries. Thus the imports in 1920 were about balanced by the exports in 1922.

The key to the future, according to this Report, continues to be the ability of the American refining industry to hold foreign markets. "Sugar refineries already built in the United States are more than sufficient to refine enough sugar for this country and also all the export sugar Cuba can produce for years to come. Washington should give the refiners power to refine in bond and so save unnecessary expense to the industry and to the Government." Apropos of this, we note that the Company laments that war-time agreements were not made to ensure for all future their war-time markets. "So dependent on the United States was Europe for sugar during the war that far-reaching agreements might easily have been obtained, assuring post-war markets as a part of the war programme of increased sugar production. No such steps were taken, and we now have before us the task of holding foreign markets. It means contending with many foreign systems of sugar taxation, customs duties and preferential tariff treaties, some designed, like our own tariff, to develop certain fields as a matter of policy."

The Immensity of a Modern Cuban Central.

Before leaving this Report, it is interesting to quote some figures given in it dealing with the working of the "American" Company's Cuban Centrals, as they are illuminative of the immense size of a modern sugar estate, and of the personnel required to work it. "Let us take Centrals Cunagua and Jaronú as an example of the raw sugar industry which supplies the cane sugar refining industry with its war material. In order to harvest the cane for 1,100,000 bags of raw sugar, each weighing 325 lbs., it requires 12,000 men at work in the fields for 150 days—9000 cane cutters and 3000 men for hauling, weighing and general duties—and 1500 ox-carts and 12,000 trained oxen to haul the cane to the railroad. In addition 1300 men are required for the two factories for the operation of the railroad system, and for administration and general purposes. To these two factories are brought 1,450,000 tons of cane, requiring 371,500 ox-cart loads, or 64,800 railroad car loads. A total of 160,000 tons of raw sugar is manufactured from the cane at the

two factories, requiring 5500 railroad box cars to move the raw sugar to ship-side, making cargoes for 40 ships for ocean transportation from Cuba to the United States. The factories operate 24 hours a day and require 432 car loads of cane every day, grinding $6\frac{7}{10}$ tons every minute, producing $44\frac{3}{10}$ tons of raw sugar every hour and shipping to the port $36\frac{2}{3}$ car loads of raw sugar every day for the entire period of the campaign."

The Risks of omitting to Advertise.

A case has recently come to light in this country of how an old-established firm, whose name was once a household word in Great Britain, has gradually come to ruin because those at the head of it persisted in the supposition that they were too well known to have any need to advertise. As it happened, they persisted too long in this negative policy and the public forgot them completely. We refer to the firm of Messrs. Day & Martin, famous a generation ago for their "blacking" for footwear. When the more serviceable shoe polishes gradually came into existence, other firms entered the market, and as they advertised freely, they began to secure the public custom. Messrs. Day & Martin, it would appear, likewise brought out an efficient polish, but they neglected to advertise it, and as a result their sales gradually dropped till last winter a crisis was reached in the firm's affairs. Then the shareholders and the public were told the position, and an effort was made to raise £50,000 extra capital with which to start an advertising campaign; but the money was not forthcoming; and the latest information is that the business is to be offered for sale in the open market.

It is difficult to contemplate any cogent reasons why a management should have persisted to the bitter end in refusing to recognise the advantages of advertising; but the moral of the story is that no firm having once acquired a hold on the public can afford thereafter to dispense with regular advertising to keep their name before the public if at the same time they wish to maintain their business undiminished.

Another paradoxical type of advertising policy which has little more justification behind it is that adopted by many firms who when business is doing well advertise freely at home and abroad, but when times are bad they cut down most of their advertising, especially the overseas section,—just the time when the plain business man would have supposed that extended advertising was needed to restore the depleted turnover. Of course if a firm are convinced that they cannot deliver the goods—orders or no orders—it is futile to advertise. But to cut down advertising just because trade is bad and expect the process to assist in the restoration of that trade is a form of mentality that we have never been able to fathom.

The Indian 1922-23 Sugar Crop: Final Memo.

The Final General Memorandum of the British Indian Sugar Cane Crop of 1922–23 issued by the Commercial Intelligence Department at Calcutta, states that the area sown was estimated at 2,721,000 acres, as against 2,395,000 acres last year, an increase of 326,000 acres or 14 per cent. The total yield of gur is estimated at 2,988,000 tons, as against 2,599,000 tons in 1921–22 or an increase of 15 per cent. In the United Provinces which accounts for 52·2 per cent. of the total, the weather has been favourable and the condition of the crop is reported to be satisfactory.

Fifty Years Ago.

From the "Sugar Cane," April, 1873.

In this number of our predecessor was published an interesting article on the theory of the action of animal charcoal. WERNEKINCK supported the idea that decolorization was due to the bleaching of the colouring matters by means of oxygen condensed in the pores of the char; but KOHLRAUSCH refuted this supposition by means of the following experiment: A quantity of animal charcoal was used for the decolorization of molasses until exhausted, and the amount of colour abstracted from the molasses was noted by taking colorimetric readings of its solution before and after treatment. Then the spent char was extracted with alkali solution until no more colour could be dissolved out, this coloured solution being suitably diluted and its degree of colour determined. It was thus found that the extract contained 98 per cent. of the colour eliminated from the molasses solution by the char, the conclusion therefore being that the colouring matter has not been oxidized by the char but had only been absorbed in an unchanged condition. KOHLRAUSCH concluded that "we can affirm that such a phenomenon seldom or never takes place in these conditions, but that the colouring matters are absorbed by surface attraction, which indeed is a well known property of char, in common with many other organic and inorganic substances, such as pumice-stone, vegetable charcoal, etc. . . . . . ."

Then another hypothesis put forward by WERNEKINCK was to the effect that the ammonia evolved during the passage of the liquors through the char filters originated from the nitrogen of the air; and he actually recommended a process for the production of ammonia, according to which air and steam were to be passed through heated char for the synthesis of NH_3. KOHLRAUSCH again attacked this theorist, and cited experiments showing quite conclusively that the formation of ammonia was at the expense of the nitrogenous constituents of the sugar liquor, these being decomposed, so that the ammonia formed was liberated with the steam evolved from the char filters.

Another paper was by Dr. B. W. GERLAND, and was concerned with the use of calcium sulphite for the clarification of cane juices for the production of white sugar, as recommended by ICERY and his colleagues. Sulphurous acid does not appear to have been used at that time directly to any extent, the custom being (in Mauritius at any rate) to prepare a solution of calcium sulphite or bisulphite from milk-of-lime on the estate, and heat this up with the juice.

There appeared a note on the capacity of the Greenock refineries of that day, in which it was stated that the total average output of that town was 4500 tons weekly, the two largest houses being owned by JOHN WALKER & Co. with 800 tons, and by the GLEBE SUGAR REFINING Co. with 750. The average capacities of the others was only about 300 tons per week.

Other articles which appeared in this issue were entitled: "Improved Methods of Sugar Cultivation in Jamaica"; "The Yield of the New Duties in France"; and the substance of a "Memorial of the Sugar Refiners of Great Britain and Ireland," addressed to GLADSTONE, praying that "representations should be made to the French Government as will lead to the holding of another Conference of the four powers who are parties to the International Convention of 1864 for the regulation of drawbacks on the exportation of refined sugar. . . . . . ."

The World's Sugar Position.

One great trouble in connexion with sugar statistics is that, while the sugar year as regards production is from the 1st of September to the 31st of August, that for consumption is the calendar year. This renders accurate comparison for the purpose of a balance sheet of supply and demand impossible. Messrs. LAMBORN & COMPANY, of New York, in a mimeograph[1] dealing with the estimates of the world's sugar supplies and consumption for 1922-23, have tackled this difficulty by bringing, with what must have been an immensity of trouble, the consumption figures into line with those of production by estimating these also for the sugar year. The details given by Messrs. LAMBORN & COMPANY have been very carefully considered, stocks and internal consumption in exporting countries being taken into account as well as those in non-exporting and non-producing countries.

The Report is divided into two parts: the one showing the supply for Europe and the Americas, and the other for the countries included in Asia, Africa, and Australia. As, however, there is a certain amount of assumption as to the direction in which sugars may go, we prefer to take the world's figures as a whole. The production figures show the total sugar made, and all the figures are in long tons in terms of raw sugar, and the summary of the situation for the sugar year 1922-23 is as follows:—

	TONS.
Estimated production	18,803,000
,, available supply	19,077,000
,, consumption	19,274,000
,, shortage	197,000

On account of the difficulty attending the obtaining of reliable figures for many countries, especially in the East, there must inevitably be a certain amount of doubt as to their sugar position. Although as a rule the countries in which this is the case are of minor importance from a sugar point of view, it is an element of inaccuracy which must be taken into account in the consideration of sugar statistics such as these. Then again invisible stocks constitute an unknown quantity of very great importance. Putting on one side, however, these disturbing features, it certainly looks from Messrs. Lamborn's figures as if the world's stocks of sugar will have been drawn upon by the 31st of August next, unless the increase in price which has taken place brings about automatically an adjustment. This effect of price, it may be remarked, is particularly noticeable in eastern consumption. In India, the high prices of 1920 reduced the imports of sugar to 280,000 tons. In 1921, following on the reactionary prices, they had risen to 529,000 tons, and in 1922, when prices were again rising, were 453,000 tons, the country's production being almost a constant figure during these three years. High prices in the West invariably attract sugars from the East.

It must not be forgotten, however, that price is not the only factor in consumption, industrial conditions also coming into play. As the Report points out, the low consumption prevailing in 1920-21 during the period of depression and high sugar prices was followed by a year of very heavy consumption in 1921-22. In the first half of this year prices were low, but in the second half they had risen, and consumption still continued to increase, although not at the same rate as in the earlier part of the year. In 1922-23 so far consumption has gone on increasing in spite of the higher prices. But if the production of sugar does not

1 "World's Sugar Supplies, 1922-23." Qto, 60 pp. LAMBORN & CO. (Statistical Department), Front Street, New York.

keep pace with it, there must of course be a limitation of consumption due to abnormally high prices.

Too much reliance, however, must not be placed on Messrs. Lamborn's forecast of a 200,000 tons shortage in the world's sugar supply. The coefficient of error in forecasting in such a complex subject would be responsible for far bigger figures than these, and a 200,000 tons shortage in dealing with 19,000,000 tons might well turn out to be a 200,000 ton surplus. In sugar notably it is the unexpected that happens, and "never prophesy unless you know" is a specially wise axiom in connexion with it.

But Messrs. LAMBORN & COMPANY have given to the sugar world extremely interesting and valuable information as to the present position of sugar in the world's producing and consuming countries in the Report under review.

The Possibilities of Assam as a Sugar-producing Country.

By J. T. J. CROOKS, B.Sc

Assam is situated north-east of Bengal, and lies between the latitudes of 24° and 27° north, and it is in the northern portion of Assam that the sugar cane is at present being cultivated. It will thus be seen that whilst Assam is in India, it is not in the Tropics, but in the Temperate Zone. From the month of November till about the end of February, the temperature is very low and quite unsuitable for the successful growth of sugar cane.

Up to the present time, very little has been done experimentally in the cultivation of the cane, or in the selection of the right varieties most suitable for this country. However, now that two big financial companies have acquired large tracts of land with the object of cultivating sugar cane and manufacturing sugar therefrom, something in the right direction may be accomplished. Having inspected these two estates and made analyses of the soils, the writer is of the opinion that this industry can be made a success if handled properly, but there are huge obstacles to be faced and overcome before this can be accomplished.

Situated at the foot of the Bhutan hills which are spurs from the Himalaya mountains, Assam has an abundant, well distributed, rainfall supply, which averages about 100 ins. per year. Its soil is very old alluvium and is composed of a light loam overlying a compact reddish yellow sandy subsoil. It is very acid in reaction and is very deficient in carbonate of lime. There is present in this soil a toxic compound, which it has been suggested is partly or wholly responsible for this acid condition. After proper drainage, the application of the correct quantity of lime, and careful cultivation, it is found that the acidity of the soil gradually disappears together with the toxic compound. To obtain the best results with this soil, the land should be thoroughly cleared of all roots of trees, scrub and jungle grasses, the former by being pulled out of the ground and the latter by being turned up to the surface by ploughing. The action of the sun is sufficient to kill these roots. The lime should be then applied in sufficient quantity to neutralize the acidity and the land be carefully cultivated. The surface soil being in some places shallow, it can be gradually deepened by cultivating a leguminous crop such as cowpeas or Mauritius beans, as a rotation crop with sugar cane, each successive green crop being ploughed in deeper. This will add more humus to the soil and make the land better and more suitable for cane growing.

The majority of the land in Assam is covered with a dense jungle, which is deep rooting and owing to the high rainfall, there is an abundance of swamps on the low-lying lands. In these swamps, the malarial mosquito breeds, and this is the cause of a great deal of fever in this district. When this country is properly drained and the high jungle cut down by opening up plantations, this trouble will automatically disappear and Assam will then be as healthy as any other sugar-producing territory. This fever has given Assam, locally, a bad name, so far as health is concerned, but it is no worse and in many cases not so bad as other lands which have become large sugar producers, as for example Cuba and Java. In these countries a great deal of pioneering work was necessary and large drainage schemes were required before they were fit to live in.

Owing to the geographical position of Assam, the growing period of cane, which is essentially a tropical plant, is limited to not more than eight months a year; during the other four months practically no growth takes place, as the nitrifying organisms of the soil appear to be dormant during this period.

The present practice in Assam is to plant cane in February and expect a crop for milling purposes at the end of the same year. This is a wrong procedure, as it is impossible to grow a plant cane crop to maturity in this time. In Natal and Zululand with equal growing conditions a period of two years is necessary for a plant crop, and on the higher altitudes of Hawaii from two to three years have been found necessary. Very few varieties of cane, even in tropical countries, mature under twelve months, and as Assam has only eight months of growing weather available, a much longer growing season is necessary. Planting there should be done after the heavy rains have ceased in June or July and the crop carried over till the end of the following year, when a reasonable crop may be expected. This period will give the cane at least twelve months of good growing weather, when it is possible that better results may be obtained and larger and richer crops produced. It is hopeless in Assam to expect a full crop of cane, with only twelve calendar months' growth, but given sufficient time Assam should produce a crop of at least from 30 to 45 tons per acre.

The selection of the right varieties of cane for this particular district can only be accomplished by planting in nurseries canes of known good qualities, from countries having similar growing conditions in equal latitudes, and carefully observing their behaviour as to ratooning, tillering, disease resisting and cropping, after they have become thoroughly acclimatized. This takes considerable time, but is unavoidable if success is to be assured. At the present time there are only a few varieties growing on a commercial scale, principally exotic seedlings from Java, Barbados, and Mauritius. These have not proved very successful up to the present, but that may be due to their being unsuitable for the Assam climate. Deep rooting canes which are not too thick are required for this district, such as the seedlings produced at Coimbatore by Dr. C. A. Barber, by crossing thick exotic Java canes with the thin canes of northern India, and are known as Co 213, Co 214, Co 210, and Co 221 together with such varieties as D 1135 and Uba from South Africa. All these canes have the properties required by the climate and soil in Assam, but in that district none has yet been tried. It is unreasonable to expect thick exotic tropical canes such as P.O.J. 100, B 247, B 376 and striped Mauritius to flourish in such a climate.

There has been no actual disease amongst the cane grown in Assam, and those produced have all been healthy, the only drawback being that the canes are short and do not give anything like a normal crop. Unfortunately pests, both insect and animal, have been unusually active and have done considerable damage to the

crops in places. A beetle known as *Alissonotum impressicolle*, which appears to have originated in the grass jungle around the plantations, is found on examination in the roots of the wild grasses as well as the canes all over the place. In this case the beetle itself and not its grub is responsible for all the damage. It works underground eating off the growing shoots and eyebuds at the base. It is also found boring in the sets of plant cane and in the stools of the ratoons. A remedy for those beetles is to swamp the affected fields, which completely destroys them. It has further been observed by experiment that no signs of these beetles are found in a crop of cane that has been planted in a field in which a green leguminous crop has just previously been ploughed in.

Rats have also done considerable damage by boring under the surface from the drains, eating up the sets of cane after they are planted. This is most noticeable in the soft juicy canes like P.O.J. 100. If the drains are filled in after the heavy rains have ceased then this trouble is impossible, as the rats do not burrow from the surface but only from the sides of the drains. Carbon bisulphide would also be an effective method of exterminating them. Jackals, Himalaya bears and elephants also seem to be very fond of cane and do a great amount of damage, which can be prevented as far as possible by the plantation being properly fenced in.

The class of labourer available for these estates is not of the best, and it is a great source of anxiety to the managers to get them to remain any length of time. As soon as they get trained to their work they want to move away somewhere else. This state of affairs can only be remedied by making the labourer as comfortable as possible, by providing him with a permanent dwelling with the object of making him settle. In other countries a small plot of land is given him to grow his paddy with the same object. Even then they are apt to migrate and leave their work suddenly without any reason. There is no kind of indenture system in force and it is doubtful, if there were, whether it would prove a success.

If the right class of labour could be obtained to work these estates on proper systematic lines, in which the plantation would obtain an honest day's work from each worker, then something might be done towards working these estates on lines that would prove payable. To get the most out of native labour, the methods which have proved successful in all other sugar producing countries should be adopted. All the labour should be divided into gangs, each gang for a specific duty and under the direct control of a European overseer, who will be responsible to the management for the working of it. The principle of leaving everything to the direction of Indian "mistries" is the curse of most of the enterprises in India. It is a well known fact that a native cannot control other natives, and only with European supervision, together with up-to-date methods, will the raw sugar industry in Assam and India on a commercial scale become prosperous.

As it is proposed to mill the canes in Assam, these should be cultivated of sufficient fibre content to produce fuel, as there is very little wood to be had for burning in this district, and the freight on coal from the Indian coalfields to Assam will be a serious item; besides it should not be necessary to require any outside source of fuel, if sufficient cane of high fibre is produced.

As India imports approximately three-quarters of a million tons of sugar annually, there is a market for all the sugar produced in Assam for many years to come, and if the proprietors of the new estates will only give them a fair chance, under competent management, there is no reason why the undertaking should not be an unqualified success, as it deserves.

Progress of the Cuban Sugar Crop.

(From our Havana Correspondent)

The 1922-23 Cuban Sugar Crop is well on the way to completion, hence we can now examine the data and estimate with some degree of accuracy its probable output. Towards the end of 1923 very optimistic estimates were made by several parties—these ranging from 4,000,000 to 4,250,000 tons, and one or two others exceeded those figures. At that time there was reason to expect a very large production, as over large areas the cane fields looked well and a heavy tonnage was expected. In certain districts, however, the rainy season continued till a later date than usual, and the atmospheric temperature did not fall enough to encourage a high sucrose content in the cane. In fact, there has been very little cold weather so far this crop, and cold weather is very necessary for increasing the sucrose content of, and ripening, the cane.

When the factories started grinding operations, it became very evident that the first estimates would not be reached, and very soon after all estimates were accordingly amended. The sucrose content of the cane was very low, and the fields were not yielding the tonnage they at one time gave promise of. While a number of factories have all the cane they can grind and will probably make record outputs, a very large number of others will close down early for lack of cane to run to the end of the crop season.

The crop is very much further advanced than it was last year and the previous year at this date, as the following figures show:—

	1923. Feb 24th.		1922. Feb. 25th.		1921. Feb 26th.
Total tons sugar delivered to seaport..	1,190,000	..	718,900	..	848,900

Not only is the harvesting very much further advanced, but the railroads have moved the sugar from the factories to the seaports much quicker than in previous years, and very little sugar is stored at the factories. Moreover, the steamship lines have quickly carried the sugar away from Cuba, and although the production to date is about 470,000 tons ahead of last year, the amount on hand in the seaport warehouses is a little less than last year's figures. Therefore, it is clear that Cuba's sugars are being expeditiously moved, and there will be no congestion of sugar on hand this year about the end of the crop, which means by that time comparatively little sugar will be available for export.

During the two and a half months grinding the production has been round about 1,720,000 tons. For the next like period the production should be about 1,600,000 tons, and after that the factories should turn out about 500,000 tons, if weather conditions are favourable for harvesting. This will make a production of 3,820,000 tons.

Of course it must be borne in mind that Cuba is a land of surprises in the production of sugar, and with the present high prices and favourable weather, the stimulus will be such that the above estimate may be exceeded.

However, the figures above quoted show that production will be less than in the two previous years; it is also seen that the sugar, as manufactured, is being transported quickly by the railways and steamships to the markets; and that when the crop draws to a close, there will not be any large amount of sugar in the warehouses here; we have already high prices in force, and the conditions as outlined indicate that very firm prices will rule for the crop as a whole.

Irrigation in the Hawaiian Cane Fields.

In recent numbers we have repeatedly drawn attention to the increasing labour shortage which is being experienced in the tropics, and the careful revision of all the field expenses in this direction which is being carried out on the Hawaiian sugar plantations. The cultivation of sugar cane requires a great deal of labour throughout the year, from the preparation of the land, through the planting, manuring, cultivating, to the harvesting of the crop. While the latter, in the absence of a satisfactory mechanical harvester, does not offer much chance of reduction at the present time, a considerable simplification appears to be going on in all stages of the cultivation, and each and every operation is being carefully scrutinized to see if a decrease in the man-days employed is feasible without a corresponding reduction in the yield of sugar. Irrigation has become increasingly important of late years in the fields, not only those where the amount of rain falling is insufficient for the growing of the crop, but also in those where the rainfall is satisfactory but where an accessory irrigation can be economically employed in increasing the amount of sugar produced. It appears however that this irrigation locks up a rather large proportion of the labour allocated to field work, and various experiments have been carried out during the last few years with the object of reducing the number of man-days employed in applying the water into the fields.

Irrigation is a vital matter in regions of periodic rains in the east, and for centuries the subject has received intensive study on the part of the cultivators. This has resulted in a series of complicated systems adapted to the various crops concerned, whether only one or two waterings are necessary or the crop has to be irrigated for the greater part of the year. Such crops are rice, sugar cane, wheat, tobacco, ground nuts, as well as fruit orchards, chillies and other garden crops, and in each case special attention has to be paid to the soil and gradient in the locality. These systems exhibit endless variations and are in the main wonderfully economical and effective, and one would have thought that they would repay a careful study; but, unfortunately, irrigation in the west differs radically in its elementary factors, and to such an extent that, except perhaps in a few minor details, such a study would probably be of little use to the Hawaiian planters. The cultivator in the east has a rare knowledge of the soil and his crop, and the limitations of his capricious climate on which he has to depend for his water supply. Although surveying as applied in the agriculture of the west is unknown to him, he has an almost uncanny instinct in levelling his fields, and his systems are built up entirely upon this knowledge of his surroundings and the use of his indigenous hoe. The necessary labour is available, and it collects, directs and distributes the water with consummate skill. In Hawaii the situation is entirely different, in that the capital, which is absent in the east, takes the place of intelligent labour as a basal factor. Much larger areas are dealt with under one management; the water is often obtained by powerful and expensive machinery and carried by costly channels furnished with every mechanical device for measuring and regulating the flow; expert engineers can be called on to survey the fields and every irrigated estate is mapped out with complete contour lines; and labour itself is imported from the east at great capital cost and the daily wage given is greatly in excess of that obtained in its native country. When all is said and done, it is a question, however, whether there is much difference in the man-acre-days employed in controlling the irrigation of the fields in Hawaii and in the east. Irrigation thus takes up a considerable proportion of the labour allocated to the plantation for

growing the canes, and it is natural that this operation should be carefully considered with the other work in the field, with the idea of reducing to its lowest limits its recurring cost in man-days. The study of this question forms the major item of the Report of the Committee appointed by the planters to deal with field work on irrigated sugar plantations during the past year, and the way in which the problem is being attacked is here presented in its main features.

Concrete Slab Ditch Lining at Waikulu.

As the provision of the water entails so much expense, it is natural that its conservation and speedy delivery should be considered of importance, and thus the improvement of the transporting ditches has been the subject of experiment. H. B. Penhallow describes a method of lining the delivery channels, evolved at Waikulu plantation in 1917 and now extended for three miles on the estate. Slabs of concrete were used for this, and it is obvious that they should prevent all seepage and, by abolishing friction, considerably increase the rate of flow. These slabs are made on platforms at the side of the ditch to be lined, of a size convenient for handling; and the ends where they meet are shaped so as to form a loose tongue and a groove junction. The slabs are placed in position in the running water against the sides of the ditch, leaning outwards Every second slab is braced by concrete bars against the earth behind it, and to the one on the opposite side of the ditch by a longer bar across the top. When several hundred feet of the ditch have been thus lined, the water is turned off for 10-12 hours, concrete flooring is put to set in the bottom of the ditch, cement grout is poured into the loose fitting tongue and groove joints between the slabs, and earth is rammed tightly between the slabs and the sides of the ditch. The result is a channel with smaller cross section but able to deal with the same amount of water as the former ditch and at a greater rate, and loss by seepage is completely ruled out.

The amount of labour employed in distributing the water to the cane rows is reduced by the introduction of various methods of "automatic" irrigation. Of these the chief at present under trial are (1) the Flume system, (2) the Modified Orchard system and (3) the Hillside or "Huli Huli" system. These are for newly laid out fields. For those already planted on the standard system of irrigation various arrangements are also described whereby they may be adapted to the new methods, and thus save a good deal of labour.

The Automatic Flume System.

The essential part of this system is a rigidly controlled artificial channel of certain dimensions and of a definite shape, designed to supply the water to a number of cane rows through a series of outlets in its sides, which can be so adjusted by shutters that the water reaches the ends of the rows at approximately the same time with a resultant uniform irrigation. For thorough percolation the flow of water is continued for about two hours longer, and during this time the water penetrates downwards and sideways so that the ground around the cane roots is thoroughly moistened. The flow is adjusted during the first few irrigations; and, after this is done, if a definite amount of water is allow to enter the channel, it automatically accomplishes its object without any interference beyond the occasional clearing of outlets which have become temporarily closed by particles of trash or other substances. The arrangement of the furrows and the construction of the channel or flume are somewhat complicated and in the Report these details are illustrated by a series of photographs and diagrams. In the following only the chief points are noted.

The method has been introduced by H. W. BALDWIN into the Hamakuapoko plantation in Maui. A large field has been newly prepared and consists of two parts in which the new method can be compared with the standard irrigation in the islands; it is characterized by "particular difficulties in the way of steep hills and gulches, all of which have been overcome with ease." The upper part, 53 acres in extent, is under the flume system, while the lower part, of 173 acres, is dealt with by the usual irrigation practice. Weirs are erected all over the field, and these are read hourly so that an accurate record is kept of all the water used on both systems. The flume lines are marked out on the contour map and are so arranged as to command a series of furrows 150-200 ft. long on both sides, after the herring-bone pattern.

The furrows are made first, two feet apart along both sides of the line of the flume. The flumes are however only designed to serve a limited number of cane rows and 700 ft. is given as the length used; after that a new flume is laid down which has a separate water supply. The flume is made of 1 in. redwood and in section is nearly twice as wide and deep. Its sides are bored to holes about 2 ins. in diameter opposite to each third furrow which is used for irrigation only, and each of these holes is controlled by a small galvanized iron shutter. The cross section of the flume is not of uniform size but varies with the number of holes which have still to be supplied; thus the flume may open with a section of 10 by 6 in. and the diameter continually diminishes until at the extreme end its section is only 3 by 2 in.

When planting is about to commence, the cane seed furrows are cleared and slightly deepened, the earth from them being thrown into the irrigation channels. The cane is then planted and the irrigation water is led along the planted furrows, directly over the sets, for the first few weeks. After four waterings have been given, the soil about the cane rows is compacted and all the plants are well up. The water furrows are now in their turn cleared and the soil thrown into them is returned to the cane rows and earthing-up thus commences. Two or three days after each irrigation the irrigation furrows are cleaned in the same way and the earth is again thrown on to the cane rows; the repetition of this operation spreads a mulch of earth, keeps down weeds along the water channel and, by the time that the cane rows cover the ground and cultivation ceases, the latter are thoroughly well hilled up. Such few weeds as appear on the bank between the two close cane rows before their leaves meet are removed by hand.

A balance sheet is appended which shows clearly the great economy of this method both in cultivation and irrigation, the initial cost of the flume, which is supposed to last for three crops, being made good early in the first season. Some interesting observations are added as to the amount of water absorbed by the soil at different stages of the crop. The freshly prepared furrows absorb a great deal by natural flow; but as the finer particles are carried downwards the earth below becomes consolidated and this prevents rapid and deep penetration. Percolation then takes place slowly and by capillary action between the fine particles, and this both downwards and laterally. Already when the water furrows come into action it is noted that far less water is needed for the ends of the cane furrows to be reached and, on the whole, the result of weir readings indicates that the new method here described not only is economical in man-days but in the amount of water used in irrigation.

The wooden flumes are found inconvenient at harvest time and require special protection when burning off the fields. An experiment is therefore being tried with slip-joint iron pipes which last longer, are more convenient to handle and need no such protection.

Irrigation in the Hawaiian Cane Fields.

Modified Orchard System.

This irrigation system was described by R. M. Allen, Irrigation Overseer on Kilauea plantation, in last year's Report, and certain observations are added in the present one suggesting improvements in its working. The field on which it is being tested is a fairly uniform one, 28 acres in extent, with an average slope of 8 in. in 100 ft. in one direction and practically level in the other. The essential part of this system is a series of "level ditches" placed more or less along the contour lines, and feeding the cane furrows which are straight and placed in the direction of the slope. When the contour lines are too irregular the line of ditches is slightly straightened, and it is found convenient to deviate a little from the contour lines so as to give them a gradual fall of about 4 in. in the 100 ft. Piercing the sides of a ditch are placed wooden or iron tubes of uniform section and all at the same level, each of which supplies a channel which passes between two cane rows. The latter are 4½ ft. apart and the tubes serving them gradually rise on the side of the level ditch until they reach the top, when a gate is inserted and a new level ditch commences. The first tube of a ditch is placed on the ditch bottom and, when a tube lower down reaches 6 in. above the bottom, the gate is inserted with a top exactly level with the upper edges of all the tubes of the ditch. The gate is made of separate strips of wood and its height can thus be easily regulated, so that any level ditch can at once be put out of action by removing one or two of the strips to below the level of the tubes, the water flowing over the top of the gate to the ditch next below. In the diagram of the fields (prepared last year) there are four lines of level ditches one above another across the field; each of these has four gates, so that there are altogether 20 sectional level ditches in the whole field. The length of these latter varies with the slope of the field and so does the length of the furrows served by each line of ditches. This matter depends both on the slope and on the character of the soil, and a great a deal of attention has been devoted to the appropriate lengths both of the sectional level ditches and the cane furrows. For cane furrows with a moderate slope, 250-350 ft. is considered suitable for the type of soil in the field, but a more porous soil will need a shorter, and a finer grained soil a longer furrow. On level land a shorter furrow is desirable, and 75-150 ft. is suggested as sufficiently long. Similar differences will be required with different gradients, so that the adaptation of the system to any field will need a certain amount of preliminary study.

The question of the early irrigations presents some difficulties, which are not felt in the Flume system already described. In the field described by Allen one preliminary irrigation was given before planting, but this year a planting machine has been used over a large part of the estate and with this watering before planting is impossible. If the sets are planted in dry land there is distinct risk of failure in germination, although this is minimized in top-planting by soaking the tops in water beforehand. The possibility of giving the first few irrigations directly over the seed, as is done in the Flume system, is being considered.

The saving of labour in the Modified Orchard system is very great. "One man takes over 80–100 acres directly after planting; attends to irrigation and replanting, and does considerable hoeing along the ditches, with an actual saving of 96 per cent. of irrigation labour. . . . . . Where irrigation takes 40 per cent. of the total cultivation labour, this would represent a saving of 38 per cent. in the total labour bill to bring the cane to maturity. . . . . . This is not a theoretical assumption but an actual case."

HILLSIDE OR "HULI HULI" SYSTEM.

This is a method designed for land which is too steep for straight line irrigation. The irrigation furrows and cane rows are laid down on contour lines and are thus parallel with the level ditches supplying them. "Contour mould boarding is done with ordinary two-mule mouldboard plough. The lines instead of being 4½ to 5 ft. apart, are 7 ft. apart and as level as possible. Following this, an implement known locally as the 'aeroplane plough' is run in the mouldboard line. This implement consists of a modified canoe-plough with two small mouldboards attached at the rear of the canoe wings." The result obtained is a deep water furrow, with two shallow cane furrows high up on its sides for which it supplies the water. The water is led into the furrow from the level ditch by a pipe which is slanting, so as not to injure the wall, and passes along the furrow as far as the section permits, when it pours through a cut made right across furrow and cane rows to the parallel furrow below. The current thus proceeds backwards and forwards, along successive furrows, down the slope as far as the next level ditch below. The level ditches are placed about 105 ft. apart and thus serve some 15 furrows each.

The last two systems of irrigation described are being tried at Kilauea plantation, presumably under the direction of L. D. LARSEN, the manager and also the Chairman of the Committee reporting. He lays it down quite clearly that the methods now being introduced at Kilauea are solely arranged for the local conditions there, and recommends slow and deliberate action in making such changes elsewhere. He is however fully convinced of their usefulness on his own plantation, has already 800 acres under automatic irrigation, besides 225 acres planted on the straight line system although not irrigated, and has introduced various forms of automatic irrigation into fields already laid down on the standard system. In these latter he finds the result rather extravagant with water and at best a makeshift, "but an excellent substitute and saving considerable labour." Each such field has to be studied individually and presents a problem as to how far and in what direction each system described can be introduced with advantage. He expects that in a few years' time the whole area at Kilauea will be changed as to methods of cultivation and irrigation.

In conclusion he draws attention to the changes in cultural methods incidental to automatic irrigation. The most striking of these is the use of cane planting machines, but of equal importance is the increased possibility of implemental cultivation on irrigated land under the straight line system of planting, not only for weed control but also for the conservation of water. Diagrams of cultivators are given for use even in the water furrows of the Hillside or Huli Huli system on steep slopes. The results thus far obtained in the reduction of the labour bill on the Hawaii plantations appear to be eminently satisfactory and there is distinct promise of further progress in this direction.

C. A. B.

The Australian Commonwealth Minister for Trade and Customs[1] has announced the the following standard for the denaturation of alcohol motor fuel: Spirit before methylation is to be of a strength of not less than 65° O.P. and to be "methylated" by the addition of 1 per cent. of wood naphtha, ¼ per cent. pyridine, and not less than 2 per cent. of one of the following :—Approved coal tar naphtha, benzol, shale naptha, petrol, gasoline, petroleum benzine, petroleum naphtha, or ether. It is claimed that this mode of "methylation" is sufficiently low in cost to allow the alcohol to be put on the local market at a cheaper rate than is now being charged for petrol.

[1] *Australian Sugar J.*, 1922, **14**, No. 6, 365.

Surplus Bagasse.

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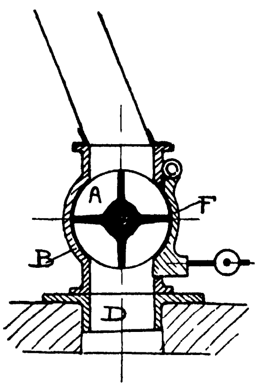
Accumulation of surplus bagasse, that is the bagasse produced in excess of the requirements of the boiler furnaces of cane sugar factories, is a sign of the operation of a factory under favourable conditions. These conditions should be the following, all or partly: (1) A sufficient high fibre content in the cane, of say over 10 per cent. (2) Efficient furnaces, working with the minimum of excess air and with freedom of air leaks. (3) An efficient steam generating plant, properly isolated and offering the least possible radiation surface. (4) The use of economical prime movers in the factory. (5) Economical layout of the steam lines and proper isolation of same. (6) Continuous operation of the crushing plant.



High Fibre Content.

The fibre contents of cane varieties differ considerably, and although cane high in fibre produces a large amount of bagasse, extraction is naturally more difficult, more maceration being required to obtain the same results than is otherwise necessary. When canes of different varieties are grown, some with a low fibre content should be mixed on the carrier with others having a higher fibre content.

Efficient Furnaces.

In many factories the furnaces can be very materially improved upon. There is often too large an excess of air used; and too often airleaks occur through open spaces on the grates, through irregular firing and through the firing mouths being left open.

Mechanical bagasse feeders are therefore to be recommended, and they can be of either the rotary or the flap type. In the rotary type the bagasse is fed through a shoot from the door in the bagasse conveyor, upon a cast-iron cylinder *A* in which large oblong cavities have been cast. The cylinder rotates in a casting *B* bolted on to the firing mouth *D*. The cylinder is an easy fit in the casting *B*, and the bagasse filling the cavities is carried by the rotation of the cylinder into the furnace mouth, and is thus regularly fed on to the grate in small portions, whilst no great amount of air can leak past the cylinder. The cylinder is driven by chain and sprocket wheels, through a dog clutch from an overhead shaft. To prevent jamming, one side of the casting *B* consists of a series of hinged sectors *F* (about five or six placed side by side) together forming one side against which the cylinder *A* rotates. In case of a serious choke, these sectors can be lifted and the obstruction cleared, while in case of a small choke, they are automatically lifted by the bagasse.

The flap type of bagasse feeder consists of a rectangular hopper box, in most cases made of steel plate, bolted to the firing mouth, with a flap in the top and a flap in the bottom. These flaps are mechanically operated by cams fixed on shafts driven by belt or chain from an overhead shaft, which cams are so arranged that first the top flap opens allowing the bagasse from the shoot to drop in the hopper; then a moment later the top flap drops shut and the bottom flap is opened, allowing the contents of the hopper to drop in the furnaces. Both feeders

work very satisfactorily when revolving cane knives are being used on the cane carrier.

To the writer's knowledge, these mechanical stokers, especially the rotary type, have given a lot of trouble in many places and have been condemned; but the trouble would very likely have disappeared in all cases with the installation of modern revolving cane knives. He has had the opportunity of observing the operation of mechanical feeders of either type in 15 new factories, and very little trouble was experienced. The feeders are clean, being entirely enclosed; while the feed is regular, and in small quantities, with the exclusion of air, thus insuring a uniform blanket of fire on the firebars. One attendant can look after several boilers with very little manual labour.

The shape of the furnaces can also in many cases be improved, and thereby their efficiency increased. Remarkable improvements can sometimes be obtained by slight alterations to the firebridges or to the combustion space in general.

It is impossible to lay down rules for final dimensions and shapes of furnaces, any more than to give the final setting for a crushing plant, before it has been in operation. If the original setting is not satisfactory, the engineer should make alterations until he is satisfied with the results obtained.

EFFICIENT STEAM GENERATING PLANT.

The efficiency of the boiler plant is another very important item in the fuel consumption. The temperature of the flue gases must be watched to make certain that the heat of the combustion has been sufficiently absorbed by the boiler water. If the boilers have to be forced, more bagasse will have to be burnt than would have been necessary had a larger heating surface been available to produce the same amount of steam. Therefore the installation of an additional boiler will often tend to produce an excess of bagasse, or prevent the necessity of using extra fuel. Attention should also be given to the boiler feed water being as hot as possible and it is an easy matter to bring this temperature to 100° C. or even over.

The regular analysis of the flue gases for CO_2 is of great assistance to the engineer to determine whether too great an excess of air is used. He can remedy this defect by either closing part of the top of the step grates of the bagasse furnaces, or by partially closing the doors, which in many cases are provided in front of these grates. If exactly the amount of air required for complete combustion had been used, the percentage of CO_2 in the flue gases would be equal to the percentage of O in the air, that is 21 per cent. Under actual working conditions a certain amount of excess air is necessary, but it should never amount to more than 35–40 per cent. Comparative daily analyses of the CO_2 in the flue gases are therefore to be recommended. It is not necessary that these be done by the chemist as apparatus exists making this analysis a very simple matter, capable of being carried out by an intelligent assistant.

The radiation surface of the boiler settings for a given heating surface is also a factor. Therefore better steaming results will be obtained with water-tube boilers than with multi-tubulars, although it must be admitted that this factor is a minor one.

ECONOMICAL PRIME MOVERS.

A very important item in the fuel consumption is, however, the class of prime movers and their number in the sugar factory.

The greatest steam consumers in a factory are direct-driven steam pumps; and the following gives the comparative consumption of steam or fuel per h.p. for different prime movers used in sugar factories.

Non-condensing	steam turbines, 300 K.W.	1·5
,,	Corliss engines	2·6
,,	High-speed engines	3·5
,,	Slide valve engines, pumps, etc.	4·8
,,	Direct-driven steam pumps	18·8

From this list can be seen how great the differences may be. An investigation into the kind of prime movers used in a factory and their number can often explain a shortage of fuel.

A similar enquiry would also explain the fuel economy obtained by driving all the pumps in a sugar factory by electric power, the current being generated preferably by turbo-dynamos. To the casual observer it would appear that first generating thecurrent, and then transferring this current again into power, would be less economical than using direct steam drive. Figures and facts, however, prove the greater economy of the electric drive, so far as the steam consumption is concerned, apart from the other many advantages which are obtained.

The exhaust steam pressure is also a great factor in steam economy; and therefore fuel consumption and proper co-operation between the members of the factory staff should keep this pressure as low as possible, and as constant as possible.

Lay-out of Steam Lines.

The lay-out of the live steam piping is also of great importance; and it is here that new plants show greater fuel economy, compared with old installations in which the steam lines have been made to accommodate additions and enlargements.

It is, of course, essential that proper isolation material should be used on the steam lines. It can do no harm to point out that the connexion flanges seldom receive the much needed isolation. Although not many engineers would leave one foot's length of steam pipe uncovered, there are many who give no attention to the flanges, which offer a not inconsiderable and a most active radiation surface.

The amount of maceration applied (which as said before must be more when the fibre contents of the cane are higher) affects the amount of moisture in the bagasse. The greatest attention should therefore be given to the last set of rollers of the crushing plant, to ensure that the percentage of moisture of the fuel shall be as low as possible. In some cases it is impossible to increase the maceration without having to burn extra fuel; and it is a matter of calculation to decide whether it is cheaper to buy extra fuel or to lose a certain percentage of sugar.

Continuous Crushing.

If all the above conditions making for fuel economy were ideally met, they would be of no avail if the supply of bagasse were not incessant, that is to say, if the crushing were not continued regularly, as near as possible to the maximum capacity of the factory.

Nothing finishes so quickly a stack of surplus bagasse which has taken days to accumulate as a couple of hours' stoppage of the crushing plant, the boiling-house meanwhile being kept going. It can be safely assumed that few modern mills have need of extra fuel if they can keep on crushing regularly, excepting factories making plantation whites, and that most will have a sufficient surplus to tide them over short stops.

If, however, something goes wrong, everything seems to tend to make matters worse. If the furnaces of the boilers are not efficient, it will be difficult to maintain the boiler pressure. The immediate result is that the prime movers will use more steam. This raises the back-pressure, again increasing the steam consumption, so that a stop must be made until the boiler pressure has been restored.

So long as conditions remain faulty, this will occur again and again; and the owners will stand aghast at bills for excess fuel, amounting to sums which would have covered many times the cost of the alterations necessary to secure fuel economy.

From the writer's experience in sugar factories in different countries, his opinion is that the lack of sufficient bagasse to operate a factory, excepting white sugar factories, can always be remedied through improvements in either the installation or the operation of the plant.

REASONS FOR A SURPLUS OF BAGASSE.

Recently he had the opportunity of observing the operation of 15 modern sugar factories in the Philippines, most of which had a considerable amount of surplus bagasse, in some cases so much that it became quite a problem how to handle it.

In the writer's opinion this was due to the favourable conditions under which these centrals worked, viz.: (1) Short milling seasons with few stops, requiring the operation of the centrals at or above the rated capacity with the result that the evaporators are worked to the utmost capacity, so that it is impossible to use much more than 20 per cent. of maceration, the direct result being a higher density of the clear juice, less impurities, easier boiling and lower steam consumption in the boiling-house. (2) The use of water-tube boilers in most cases. (3) The use of mechanical stokers. All these factories use one or more sets of revolving knives on the cane carriers. (4) Air regulating doors on the grates. (5) The use of electric drive, resulting in short steam mains. (6) The use of large Corliss mill engines driving two or more mills, instead of the use of individual engines for each mill or crusher. (7) Co-operation between engineer and sugar boiler. (8) The manufacture of raw (96°) sugar.

Owing to the improvements in installations and methods and increased capacities of the factories, many of the Java factories during the last few years have also obtained a large amount of surplus bagasse.

The disposal of the surplus bagasse was only satisfactorily dealt with in Java and in the Philippines, by baling it immediately after leaving the surplus chute at the end of the bagasse conveyor.

Before this system was adopted it was usual to keep the fire room free of bagasse by using an exhauster or a surplus conveyor. The exhauster is simply a 10 in. or 12 in. light pipe in which a steam jet is directed in one end. The bagasse is shovelled in that end and is exhausted through the other, forming a pile outside the boiler-house, which pile can be enlarged by shifting the pipe in a suitable direction. This method is cheap but the fine particles fly round everywhere, and are a great nuisance; whilst the problem of handling the bagasse back to the furnace when required still remains unsolved, since it requires a great amount of manual labour.

The surplus bagasse conveyor is very expensive, necessitating a large structure to support the continuous conveyor and discharge bagasse from the top all along the conveyor, whilst the arrangement is such that the conveyor returned on the ground level, afterwards elevating towards the carrier in the boiler-house. It was, therefore, only necessary to handle the bagasse back on this carrier.

BALING.

Baling has been proved to solve the difficulties which both methods of handling bagasse in bulk presented. Two balers and a gang of 10 men per shift have been found to be ample to deal with the surplus bagasse of a factory grinding 1000 tons of cane per day, baling and stacking.

In case the stored bagasse is required for the boilers, the transport of the bales to the firing mouths is easy, and the firing is far easier than with wood. The millyard will be free of dust, and the installation is not very expensive.

Horizontal balers have been found to be preferable as they work continuously; the bales are more easily handled; and the size of the bales can be more easily varied. The baled surplus can be neatly stored away and insured (at least in Java) against fire risk.

Excess bagasse stored in bulk is considered to represent an undesirable fire risk, and in such a condition the insurance companies do not wish to insure it. Stacked bagasse will not burn spectacularly like a haystack; but smoulder away, either when ignited from the outside, or by spontaneous combustion by heat created in the centre of the stack when damp bagasse has been stacked. Further, it is often found that the centre part of a large stack of bagasse when piled in bulk has after a year very little value as fuel, yet a great stack of bagasse represents a goodly amount of money, which might have to be spent in buying wood or other extra fuel.

On the other hand, baled bagasse a year old, when stored under cover after having been well dried in sun and wind will have a superior fuel value to freshly baled bagasse.

Insurance companies in Java are prepared to insure baled bagasse stored under "dadoek" (nipah) cover for 1½ per cent. per year, which at an estimated value of 30 cts (Dutch) per picul equals 37½ cts per 1000 piculs per month. The premium, when the bales are stored under fire proof cover is only ½ per cent. per year.

Baled bagasse will of course be stored as emergency fuel to tide the factory over stoppages; to serve if possible as fuel during the off-season; for steam trials; and for the starting-up in the following season. In some cases the excess is even sold outright to less fortunate neighbouring factories.

Baled Bagasse for Locos.

Efforts have been made, especially in Java, to convert the bagasse into a more universally suitable fuel; and therefore experiments have been carried out on compressing it into small hard briquettes.

In the beginning this was only done with year old bagasse, but later also with bagasse only four months old. The great advantage of these briquettes was that they could be used for firing on locomotives, the general opinion being that it was impossible to burn loose bagasse or even baled bagasse on locomotive grates. It was considered that not only was the baled bagasse too bulky, but also the draft in a locomotive boiler was too high to make the burning of the bagasse practicable.

After many experiments however, one of the Java factories, Pleret, succeeded in running the whole of their locomotive service on baled bagasse; and the Java Experiment Station issued a report of their investigations on this plantation. The most important part of this report reads as follows :—

The factory milled 14,000 piculs of cane per 24 hours. The locomotives transporting this cane were four in number all being of the same make and power; viz., Orenstein & Koppel manufacture and 60 h.p. The total axle load of each was 13 tons. The type was twin compound Mallet B–B; therefore, they had two high and two low pressure cylinders, each set working on two coupled axles. The total grate service was 0·60 sq. m.; the heating surface of the boiler 21·36 sq. m.; the steam pressure 180 lbs.

At the start a good quantity of last year's baled bagasse was available, which was used first. There was a good deal of opposition from the side of the native

stokers and drivers; and, as it was policy to overcome this opposition gradually, a certain quantity of wood was allowed at the start, this being speedily reduced to five pieces per day, which quantity served thereafter only for emergency purposes.

When the stock of year-old bales was exhausted, it was necessary to use fresh bales, a thing which the personnel declared to be impossible. The fresh bales were indeed very inferior as fuel, as compared to the old bales, as they had only been in stock for a few weeks and contained a good deal of moisture. For this reason a good supply of wood was again granted, and as thereby the use of bales was again reduced, it was possible to accumulate a supply, so that the bales given for use on the locomotives were somewhat older.

It appeared that bales could be ready for use on the locomotives three weeks after baling, provided that the following precautions were taken:—The bales were stacked in the open, immediately after leaving the baler. The stacks were not more than four bales high, and the bales so arranged that the wind had free access to the interior of the stack.

The bales were made much shorter, not only to reduce the weight, and thereby make the handling easier for the locomotive workmen, but also to increase the external surface per picul weight, to facilitate the drying. Two balers were used, producing bales 35 × 45 cm. by 55-60 cm. long. The weight of a fresh bale was 70-75 katties (Java). The allowance of fire wood was again gradually reduced to five blocks per day as before.

When we visited the factory, all troubles had been overcome, and the whole of the locomotive service was arranged to use newly baled bagasse as fuel. As there was a great quantity of excess bagasse, the balance was stored to be used out of season for the transportation of portable track, manure, and seed cane, and naturally also for the factory steam trials and starting-up.

The extent of the railroad and the gradients are of course of great importance when regarding the possibility of bagasse firing in locomotives. The Pleret factory is situated at an elevation of about 17 m. above sea level. The railroad going North is at its lowest point 2 m. above sea level, and the railroad going South at its highest point 80 m. above sea level.

The cane coming from the North must therefore be hauled up-hill and the worst gradient is 1 in 257 over a length of 700 m. This is not severe, but it is impossible to take it at speed owing to a curve and a bridge at the lowest part of it. The locomotive, fired with bagasse, took this gradient easily with 25 trucks, carrying 976 piculs net of cane, the gross weight of the train being 1284 piculs.

On another branch of the North line a locomotive easily hauled 26 trucks with a net load of 1925 piculs of cane. We think that we can say that the Pleret railroad can be taken as a fairly good average example of a Java railroad.

No special difficulties were encountered in stoking the baled bagasse. The bales were accommodated as follows: ten bales on the tender; five bales on the footplate; and 12 bales on the two water tanks alongside the boiler. The bales on the water tanks were wired together, until required. The wires of the bales in the tender and on the footplate were cut when the bales were loaded; and the dividing up of the bales into three slices (each representing a stroke of the baler) was an easy matter. The breaking up of these slices into pieces was less easy. As a rule pieces representing one-sixth of a bale were fired at a time, the scraps being shovelled in from time to time.

No changes were made in the firebox; also no shoot was used, as there was no room to accommodate one, the ordinary firing door being used. For this reason the stoker had to tend the fire in a kneeling position. It was only necessary to pay attention to the following:—

As the firebox was constructed for wood or coal-firing, the depth was not great and care had to be taken that the lower boiler tubes were not blocked by the fire. Care had to be taken that the fire was low at the tube plate and sloped down from the fire door opening.

It might be said that the frequent opening of the fire door and the entrance of cold air would be detrimental to the tube plate; but at Pleret the most careful inspection failed to detect the smallest crack, even after two years of bagasse firing. Therefore, we believe that no bad effects need be feared if proper attention be given by the fireman.

A disadvantage is the presence of fine bagasse dust, which is liable to be blown in the eyes of the driver and fireman, so that the wearing of goggles is advisable. No bad effects were experienced by the expected choking of the tubes and smoke-box by ash and bagasse particles. The quantity of ash in the smoke-box was not even extraordinarily large.

Concluding, we can say that, at least on the Pleret estate, the firing of locomotive boilers with baled bagasse has been proved to be successful without necessitating alterations to the locomotives and without reducing their capacity to any great extent.

Bagasse for Paper Manufacture.

As a suitable raw product for the manufacture of paper, many attempts have been made to establish paper mills in connexion with factories producing a large amount of surplus bagasse. In most cases this has not been a success financially. Paper mill machinery is not cheap, and should be kept in production all the year round and at full capacity. To operate a very small installation, because of a limited quantity of raw material, would make overhead expenses too high. The paper, which naturally is a cheap one, would have to be transported to the market centres, where it would be in sharp competition with papers produced under very favourable conditions from woodpulp or cheap cellulose, on which considerably less freight has had to be paid to market the finished product. Therefore a paper mill in conjunction with a sugar mill has little chance of success, unless there is a local market for the particular class of paper produced.

In the Hawaiian Islands such a paper mill has been established. The paper produced is used in the cane fields to kill weeds by being laid in strips over the newly planted seed cane.[1] The weeds are smothered but the sharp cane stalks penetrate the paper. It is reported that this method is very successful in keeping weeds down during the most difficult time of the growing of the cane. The conditions under which this paper is used have made the installation of a paper mill a financial success, although it can hardly be called a commercial enterprise. It would be prohibitive in cost to import paper to the Hawaiian Islands for this purpose of weedkilling, but it pays very well to manufacture it locally.

In regard to this process of mulching, it is said that a considerable amount of money is saved in labour, which would be necessary for hoeing, apart from the injury which this operation often does to the cane. By the application of the paper the cane gets a good start over the weeds, labour is saved, and production increased.

Recently in Louisiana, surplus bagasse has successfully been used to manufacture sheets for building purposes.[2] The bagasse is mixed with binding materials and pressed in thin sheets, similar to asbestos sheets, rock sheets, or beaver boards, for use in the building trade. The binding materials are said to make the finished sheets fire-proof, and excellently suitable for building purposes. It is expected that a greater field of application awaits the producers of these sheets than can be reached by the manufacturers of paper.

[1] *I.S.J.*, 1917, 445; 1919, 626; 1920, 351. [2] *I.S.J.*, 1922, 325.

Caking of Sugars.

By E. WUTHRICH,
(of Mitchell & Wuthrich, London).

With reference to the interesting article by W. F. V. H. DUKER,[1] entitled "The Cause of the Caking of Raw Sugars," a brief note giving some experience and conclusions of the writer may be of interest.

CAKING OF RAW SUGARS.

Cargo Sugar. Dutch Standard 12-14, also 16 and higher.

The factors influencing the caking of these sugars may be summarized as follows:—(1) Moisture of the sugar; (2) quality of the sugar; (3) process of manufacture; (4) temperature at time of bagging; (5) weather and climatic conditions; (6) conditions of transport, and type of the storage buildings.

As a result of experiments made both in the factory and the laboratory, and from later experience, the writer learned that certain of these factors by themselves, or several of them working in conjunction, may cause caking of the sugar.

Experiments were carried out at various periods of the season, extending over a considerable time, the moisture content, polarization, and viscosity of the sugars being carefully determined. Bags of suitable size were employed for the laboratory and ordinary bags for the factory. Piling of the sugar was followed out in various places in the factory at normal height, in both dry and moist situations; a small room where lime was stored was selected as one of the dry places of the factory. Weights placed upon planks were used as a substitute for piling in the laboratory.

Further details and figures from the experiments need not detain us here, as it is rather the working conclusions formed which are of interest.

(1) MOISTURE OF THE SUGAR.

(*a*) *Sugar of high moisture content.*—Sugar with a high moisture content, say 1 per cent. and more, was found invariably to cake when brought into surroundings where part of its moisture evaporated or "dried out." On the other hand, it was found that caking did not occur as long as the moisture content remained high.

Even in surroundings where the atmosphere is very humid, such sugars may lose part of their moisture and may cake, but the caking will increase considerably when the bags are sent to countries and stores where the atmosphere is much drier and where there is opportunity of losing more moisture during storage. This explains why caking nearly always takes place at the sides of the bags, while the sugar in the centre remains loose. But the latter may also cake more or less if the bags are stored for a considerable time.

What occurs in the manufacture of brick-sugar is in accordance with the above. As will be known, this sugar is made by crushing white sugar of say 99·3 polarization or higher, to flour. This is then moistened with water, and from this moistened sugar-flour bricks are made by machine-pressing the sugar into moulds. These bricks, although the sugar adheres together, are at first quite loose and can easily be converted to flour again as long as they are wet by gently pressing with the fingers. As a matter of fact, at that stage they cannot be called bricks as they have not yet caked. But after they have been dried in a special oven for a certain time, say 14 hours or longer, they are converted into hard stony bricks, which certainly can be called "cakes." The sugar has then lost nearly all its moisture, the Brix being 99·9 and very often 100·00.

[1] *I.S.J.*, 1923, 131.

Here is a sugar of high polarization, with a minimum of gummy matters or else none at all, which cakes by simply losing its moisture. It is the losing of this moisture, and not the high moisture content itself, which is the cause of the caking.

While the pressure due to piling no doubt affects caking, both as to density and thickness, acting in a similar manner to the machine-pressure of the bricks, this pressure was found not to be the main factor, for it was clearly shown that any bagged sugar liable to cake will do so without pressure, though not to such an extent, and not so quickly.

If we were able to maintain during transport and storage the high moisture content of the bags, caking would not take place. As this is practically impossible, just as it is impossible to avoid pressure due to piling, the only means of overcoming this main cause of caking is to deliver the sugar dry, or with as low a moisture content as possible. In passing, we may also note that low moisture content is of great importance with a view to avoiding deterioration of the sugar.

Mr. F. T. Conant, in the above-mentioned article, states that after a better washing of the sugar, and consequently the production of looser crystals, the moisture content remaining unchanged, no complaints other than those relating to lots which had been stored near the boiler of the steamer, have been heard from the refinery.

Mr. Conant does not mention the water-content of this sugar, but the writer suggests that it was about 0·7 to 0·8, and that owing to the heat of the boilers part of this moisture evaporated, causing the caking of the sugar stored near the boilers, while the part stored away from the boilers kept about the same moisture content and did not cake.

(*b*) *Sugar of low moisture content, 0·3 to 0·4 per cent.*—Normal sugar with low moisture content will not cake, whether cold or hot bagged, as long as it is not exposed to a very humid atmosphere and later on again to a dry atmosphere; for, as long as it keeps its low moisture content, caking of normal sugar will not occur. In the cane-growing countries, however, either during the whole year or part of the year, the humidity of the air is high and the moisture content of the sugar will increase, not only by the hygroscopic nature of some of the non-sugars, but also because the moisture of the air penetrates between the crystals, so that some of the moisture may condense to water when during the night the temperature drops. When later on this sugar arrives in an atmosphere of lower humidity than it has itself, some of this water may evaporate and thus cause caking.

However, the attraction of this moisture takes a considerable time, and when the sugar is not kept too long in the country where such high humidity of the air prevails and is despatched with not too long a delay to a country where the atmosphere is less moist, there will be no caking of normal sugar.

(2) Quality of the Sugars.

The foregoing remarks refer to "normal sugars." For if the sugar be abnormally viscous and sticky, it will cake no matter whether it has a low or high moisture content; and no matter whether it is bagged cold or hot.

Further, small grain sugar is much more susceptible to caking than large grained sugar. Especially sugar with high moisture content cakes very soon when the grain is small.

The opinion of Mr. Herbert Walker that the actual cause is the formation of a supersaturated syrup film around the crystal at a certain temperature,

crystallization setting in later when the temperature has fallen, seems to the writer to be a sound one. However, the writer believes that not only a fall in temperature will cause this crystallization, but *mainly* evaporation of the water, caused by a surrounding atmosphere which is not saturated with moisture.

That crystallization takes place in one or other of the above ways, or in both, and that it is not necessarily a question of gummy matters, or any other matter causing the caking, receives strong support, not only from what is said above about the manufacture of brick sugar, but also from the fact, referred to later on, that even white sugars of high polarization will cake when they are very moist. In this case no gummy matters are present, and caking must be due to the grains cementing together, owing to other sugar crystallizing out. No doubt also, with raw sugars which are abnormally sticky, both cementation due to the gummy matters, and crystallization, may operate at the same time.

The smaller the grain, the larger the surface of a given quantity of sugar, and the greater the chance of its being cemented together.

Large grain sugars, moreover, have always a lower moisture content than have smaller grain sugars made by the same method of working, on account of the total surface of the crystals being less, so that less water adheres to the crystals when leaving the centrifugals and on their way further on.

(3) PROCESS OF MANUFACTURE.

Reference here is made to the way in which clarification is carried out, and the process of working-off the syrup.

A well conducted clarification of raw juice, and the method of handling of the clear juice and syrup will undoubtedly affect the caking of the sugar, and this needs no further explanation.

As to the working-off of the syrup, some factories in one way or another mix the lower product sugars (from massecuites giving exhaust molasses, or from string proof boilings) with the sugars of massecuites of higher purity. This makes the sugar more liable to caking.

(4) TEMPERATURE AT BAGGING.

Hot bagging of sugar of high moisture content will increase the chance of caking considerably, since it helps the water to evaporate. Hot bagging of sugar of low water content does not influence the caking of normally dry sugar, but does do so when the sugar is abnormally viscous and sticky.

(5) WEATHER AND CLIMATIC CONDITIONS.

From the above the conclusion may be drawn that weather conditions and change in these conditions, in both the country of origin and destination, and also a difference in the climatic condition of these countries, form a great factor in the formation of caked sugar.

(6) CONDITIONS OF TRANSPORT AND ARRANGEMENT OF STORES.

That the conditions under which transport takes place are of importance, may be seen from the instance given below of a white sugar caking from no other cause than transport in open trucks.

As to the arrangement of the stores, there can be no doubt that this must influence the caking of sugar considerably. If the air in a store becomes too hot or too moist, this will increase the chance of caking.

CAKING OF WHITE SUGARS.

White sugars, even those with a polarization as high as 99·4 to 99·6, can also cake. An interesting case may here be referred to, where caking occurred, not in a solid mass of considerable thickness, as happens with raw sugars, but rather by the formation of hard lumps, both large and small, along the sides of the bags, the centre of the bags being free of lumps, which, as a matter of fact, are the same as caking. The circumstances under which this happened were the following :—

The factory concerned was 150 miles away from the place of destination of the sugar, and it took about 14 days for the sugar to travel this relatively short distance. The greatest part of the sugar was transported in open trucks, covered with tarpaulin only ; part was sent in closed, ventilated trucks. Complaints about caking were received in the hot and rainy season. In the country in question the temperature during this part of the season is very high, but the nights are cool. The humidity of the air is also very high and there is a heavy dew. The sugar when sent away was perfectly dry. It was soon discovered that the sugar loaded in closed trucks, ventilated by small shutters at the top, did not cake at all, and that the complaint concerned only the part of the sugar conveyed in open trucks.

Sugar from one and the same crystallizer was found to have been conveyed part in open trucks, part in closed; no caking occurred in the case of the part conveyed in closed trucks, so that the proof was conclusive.

It was also found that the sugar did not cake when stored at the factory and that the caking only took place during transport and in the stores at the place of destination. Nothing was wrong at the stores; they were well built, well ventilated, and had brick walls.

What happened was this. During the long transport in open trucks, and owing to the heavy dews, the sugar became very wet; the sun in the daytime caused drying out and caking, and later on in the stores evaporation was continued. Probably cooling down during the night operated along with the heat of the daytime, so that during the day the crystals cemented owing to crystallization by evaporation, and during the night owing to crystallization by cooling down. The real cause, however, was the excess moisture, without which neither of the two changes would have occurred.

MEANS OF PREVENTION.

(1) A good well conducted process of clarification, and the proper handling of the clear juice and syrup.

(2) A suitable process for the working-off of the syrup.

(3) The production of grain of regular and reasonable size, small grain being avoided.

(4) Proper treatment in the centrifugals, driving out as much molasses as possible, while keeping in view the quality of the sugar desired.

(5) Drying of the sugar, the water content being 0·3 or lower by preference.

(6) Cooling before bagging.

(7) Transport on land in closed trucks.

(8) Storing in well-constructed, well-ventilated stores; the ventilation to be such that no draught or wind strikes along the bags. The ventilators should be closed at night.

If these points are well attended to there will not be much caking.

Comparison of Efficiency and Costs in Bone Char and Decolorizing Carbon Refineries.

By GEORGE AVOT.
Sugar Technologist, Darco Sales Corporation.

When a new process challenges the monopoly of an old one that has become entrenched as the essential feature of a great industry, like the refining of sugar, it may be readily understood that a contest is inevitable. This contest is now engaging beween decolorizing carbons of vegetable origin and decolorizing char made from animal bones.

Bone char has many able defenders and articles have appeared recently in technical and trade journals presenting arguments which are logical in so far as they deal with the efficiency and long life of bone char, but which are not altogether fair towards vegetable carbons in offering criticisms that are based simply on inconclusive laboratory tests.

The importance of decolorizing carbons of vegetable origin to the sugar world warrants the most thorough checking of laboratory findings by results obtained in actual factory or refinery practice. Fortunately, actual process data are now available, for there are several combination sugar factories and refineries using carbons in Louisiana and abroad, which refine raws successfully into a standard refined sugar, the equal in every respect of the best bone char product.

The following observations and comparisons of bone char and decolorizing carbon are drawn from actual refinery results and are submitted, not in a controversial spirit, but as a contribution toward a better understanding of the subject.

Losses during Revivification.

When working on remelt sugars of 98·5 to 99·2 apparent purity the amount of decolorizing carbon used varies from 1·2 to 1·75 per cent. (dry basis); and the average colour removal, measured by the Hess-Ives tintometer, varies from 89 to 98 per cent. of the original colour. To do the same work an average of 90 lbs. of bone char per 100 lbs. of raws remelted are used in bone char refineries.

Even with figures most favourable to bone char, say 1·75 per cent. carbon as compared with only 75 per cent. bone char, the proportionate ratio of decolorizing power is $75/1{\cdot}75 = 42$ times, and not 12 times, as has been stated.

It is claimed that certain carbons have a decolorizing power 100 times greater than bone char.

Nowhere is such an amount as 4 grms. of carbon per 100 c.c. of sugar solution used, and nowhere in factory practice is the carbon used seven times without washing and reburning. After two or three uses, the carbon is sufficiently exhausted, and no further application of it can be made with satisfactory results in decolorization or filtration. It must be added that an exhausted carbon offers considerable difficulty in obtaining a good revivification on account of the impossibility of the wash water penetrating the pores completely. Another thing, in factory practice the heaters always work at 212°F. (100°C.) or more, and not at 80°C. as has been claimed; and the amount of liquor used in proportion to the carbon is much greater than has been stated, and this is able to change the rate of adsorption. Further washing with caustic soda is objectionable, and in present factory practice the only chemical washing of carbons is with acid.

Now if we compare the known losses in bone char revivification, and the estimated number of cycles, the estimate that bone char may be used 150 times appears somewhat high. In bone char refineries, a total loss of 1·8 per 1000 lbs.

of sugar melted is a fair average; and in a factory working 1,000,000 lbs. daily, using 90 lbs. of bone char per 100 lbs. of sugar, and with a cycle lasting 72 hours, there must be one-third of 900,000 lbs. of bone char reburned daily, or 300,000 lbs. with a loss of 1800 lbs. In 225 days, the period mentioned in a recently published article, there would be a loss of 405,000, i.e., (1800 × 225) lbs. from the original stock of 900,000 lbs. or 45 per cent. in less than eight months.

Taking into account the constant decrease of stock, we have, for the first year 225 days in cycles of three, or 75 reburnings; for the second year we have only 55 per cent. of the initial stock or, 75/55 = 41 reburning; and for the last year, about 10 to 12 per cent., or 75/10 = 7·5 to 8 reburnings. That is a total of 75 + 41 + 8 = 124 reburnings to destroy all of the original stock of bone char. Now with decolorizing carbons we have not 150/12, but 124/42, i.e., about 3, as comparison figures, and therefore a carbon capable of being used in three cycles is able to compete with bone char. In practice, a much better result is obtained.

With carbons, the losses in reburning do not exceed 4 per cent., in fact very often only 3 per cent.; and this means, considering the stock as 100, 25 cycles at least before all of the stock will have disappeared. In practice, although the breaking up of the particles of carbon decreases the rate of filtration about 20 per cent. as compared with new carbon, the fine particles disappear at the beginning as mechanical losses and in reburning. Therefore their presence does not prevent the carbons from being reburned until they disappear completely as losses. In fact, no carbon is ever thrown out of process; the losses are simply compensated for by the introduction of fresh carbon in the process. We have given 4 per cent. as a basis for these carbon losses, but we know of a carbon refinery where the losses for 13,000,000 lbs. of sugar have been only 6000 lbs. of carbon, or 0·46 lbs. per 1000 lbs. of sugar melted. This refinery worked on a basis of 1·7 per cent. carbon, and with a production of 180,000 lbs. of sugar daily, there were 3060 lbs. of carbon reburned each day; and for a working period of 72 days, the duration of the crop season, there were 220,320 lbs. of carbon reburned. Therefore the losses were 6000/220,320 lbs. = 2·7 per cent. to 2·8 per cent., i.e., 2·8 lbs. per 100 lbs. reburned (100/2·8) or 35 cycles. We are therefore far away from the figures of 18 cycles as stated in the published article referred to.

Limit of Cost of Carbon.

With the life of vegetable carbon lasting throughout 25 to 35 cycles, and assuming the cost of bone char to be 5 cents per lb., the following comparisons may be made. We have found that a carbon working three cycles is equivalent to bone char; and if the carbon should be used 25 cycles or 8 times more, then the cost of the carbon to be equivalent to bone char at 5 cents per lb. can reach the figure of 40 cents per lb., instead of reaching its limit at 7 cents as has been erroneously asserted. As a matter of fact, the market price of carbons ranges between 15 and 20 cents per lb., and have therefore double the intrinsic value of bone char.

Absorption of Ash.

Bone char is known to absorb mineral matter, etc., from the sugar liquor, whereas this property is not possessed to the same degree by dècolorizing carbon. This is the only point more or less favourable to bone char. Certainly it is entirely incorrect to say that carbons do not remove any ash. Carbons remove chiefly iron, calcium, and silica; and after a very short time their ash increases from 12 to 15 per cent. of their original content, unless subjected to the acid wash in the daily routine. Of course it cannot be expected that 1·5 lbs. of carbon will remove as great an amount of ash as may be removed by 75 to 100 lbs. of bone

char. Yet chemical comparisons of standard refined sugars made by the bone char process and by carbons have shown very small differences in ash content. When using bone char there is an average of 0·12 to 0·15 per cent. ash, and with carbons, 0·18 to 0·20 per cent. This difference is not sufficient to justify a serious criticism, and moreover the ash content is not the only impurity which prevents the crystallization of sugar in molasses.

QUESTION OF YIELD OF SUGAR.

If even a higher percentage of molasses is made, and this does not seem to have been completely proved in practice, this will be more than compensated for by the excessive losses of sugar left in bone char as compared with the losses of sugar in carbon cakes.

A carbon refinery working 1,000,000 lbs. of sugar daily, will have about 15,000 lbs. of carbon to reburn; and with 40 per cent. moisture, about 25,000 lbs. of filter cake in which the sugar content, after sweetening off, is no more than 0·1 to 0·2 per cent., or a maximum loss in the cakes of 50 lbs. of sugar daily. Comparing this with sugar losses in a bone char plant of equal capacity, with a sugar content after washing as low as 0·2 per cent., and using for the same work 300,000 lbs. dry bone char reburned daily and adding about 20 per cent. moisture content, a total of 360,000 lbs. of wet char is obtained which means a loss of sugar of 720 lbs. The net result is a saving of 670 lbs. of sugar daily by the use of vegetable carbons. The yield by the use of carbon is also increased through the shortening of the process, and the reduction of the losses due to inversion under the same conditions. Even with a slight alkalinity, the liquors in the bone char filters always increase their glucose content. In fact, we know of two vegetable carbon refineries of small size and with less perfect equipment than some of the large bone char refineries, working respectively 180,000 lbs. and 300,000 lbs. of raws daily, averaging 95·45 and 95·55 polarization, having obtained yields of 92 and 92·6 of standard granulated sugar per 100 lbs. melted. How many bone char refineries have achieved better results?

OTHER ADVANTAGES OF CARBONS.

Now we consider the sweet-waters. For 25,000 lbs. cake as indicated before, we need approximately 90,000 lbs. of water to exhaust the cake to 0·1 to 0·2 sucrose content. On the other hand, for 360,000 lbs. bone char exhausted to the same degree, 400,000 lbs. of water are required, or over four times as much as for carbon; and the additional cost involved in the evaporation of 300,000 lbs. of water is manifestly quite important.

Then something must be said regarding the mechanical equiment and the stock of carbon in storage. There is a saving of about 30 per cent. to 40 per cent. in the cost of the equipment. The stock of vegetable carbon in storage for 1,000,000 lbs. sugar remelted daily is 60,000 lbs., against 2,000,000 to 2,500,000 lbs. of bone char, a difference in invested capital of over $100,000 in favour of carbon.

Replacement losses with carbons amount to about 500 lbs. daily, value $75 and for the bone char, 1800 lbs. value $90. For revivification, the cost of 15,000 lbs. of carbon reburned, at the rate of 0·75 per lb. is $112·5 and for the bone char, at the rate of 0·10 per lb., about $300.

In conclusion, it may be said that in respect of every detail, except the slight difference in ash absorption, the best vegetable decolorizing carbons possess a decided advantage over bone char. It is conceivable that many of the existing refinery installations, and certainly most of the new ones of the future, will substitute, wholly or in part, a powerful vegetable carbon in place of the less efficient bone char.

The Synthesis of Sugar by the Plant.[1]

By Prof. E. E. C. BALY, B.Sc., F.R.S.,
The University, Liverpool.

In the first place there is the well-known process whereby formaldehyde is burnt with oxygen to give carbon dioxide and water, with the evolution of a large amount of energy, the equation being $CH_2O + O_2 = CO_2 + H_2O + 130,000$ calories.

PHOTO-SYNTHESIS OF FORMALDEHYDE.

The reverse process, namely, the production of formaldehyde and oxygen from carbon dioxide and water, is bound to take place, provided that sufficient energy is available, the reaction being highly endothermic. It is impossible to realize the process by the ordinary methods of heating, etc., owing to the very large amount of energy necessary. It is, however, possible by the use of light energy to bring the reaction about, since carbonic acid has the power of absorbing ultra-violet light of very short wave-length, and without discussing in detail the energy quantum theory it is established by this theory that the energy thus absorbed is just the right amount to stimulate the reaction. We have proved this fact by a variety of methods, and have demonstrated in several ways that formaldehyde is produced from carbonic acid by the action of ultra-violet light.

We have also proved in more than one way that if the carbonic acid is in combination with a visibly coloured basic substance the formaldehyde is produced when the compound is exposed to visible light. The importance of this lies in the fact that it explains the function of the chlorophyll in the leaves of the plant, since chlorophyll forms a compound with carbonic acid and this compound gives formaldehyde on exposure to sunlight. The energy relations of this process are more complex since there are present four pigments, chlorophyll A, chlorophyll B, carotin, and xanthophyll, and all these have their own rôle in the four-component equilibrium which is both chemical and photochemical. This complexity, however, does not alter the fact that the chlorophyll combines with the carbonic acid, and on exposure to sunlight gives formaldehyde.

POLYMERIZATION OF REACTIVE FORMALDEHYDE.

The second point is one of considerable interest, for the formaldehyde molecule when first formed by this photochemical method is not in the same condition as the ordinary formaldehyde molecule and contains far more than the normal amount of energy. This highly reactive formaldehyde does not, as is usually the case, lose its excess of energy and change into the ordinary form, but instantaneously undergoes chemical reaction. If no substance is present to combine with this active formaldehyde, it polymerizes at once into sugars which are hexoses and have the general formula $C_6H_{12}O_6$. These sugars are perfectly definite entities, for we have succeeded in preparing their pentamethyl derivatives. A critic remarks that we have made a syrup which might be a sugar, but in saying this he understates what we have done. Our syrup certainly contains sugars which have been definitely established to be hexoses, and therefore we know far more about it than is suggested by the words "formose whose composition is unknown." We have even more information than this, for we have found some evidence that the synthesis goes beyond the simple sugar stage, and that more complex bodies are formed of the nature of polysaccharides. Since this is actually the case in the living leaf, it is by no means extraordinary that we should find the same process in our experiments.

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1 Abridged from *Chemistry and Industry*, 1923, 42 (new series), No. 11, 256-258.

SYNTHESIS OF PROTEIN SUBSTANCES.

Something may be said of what we have done on the nitrogen side of the problem. It is known that plants absorb nitrates from the soil, and that as a result nitrates or nitrites are present in the leaf. It has further been found that when the leaves are kept in the dark the nitrates or nitrites are equally distributed throughout the leaf, but that these salts disappear if the leaves are exposed to light when chlorophyll is present. In an etiolated leaf where chlorophyll is absent these salts are unaffected by light. We have found that, whereas freshly synthesized formaldehyde in the absence of salts polymerizes to give sugars, if a nitrate or nitrite is present the formaldehyde preferentially combines with it to give formhydroxamic acid, and that this acid then combines with more of the active formaldehyde to give more complex compounds which I will deal with later. Further, when the formaldehyde is produced at a greater rate than can be utilized by the nitrate or nitrite and the first synthetic product, formhydroxamic acid, the excess polymerizes to form sugars.

These observations seem to be of some importance for three reasons. In the first place, they explain the disappearance of the nitrate or nitrite from chlorophyll-bearing leaves in sunlight. In the second place, they prove that many of the nitrogen compounds present in plants can be directly synthesized from carbon dioxide, water, and a nitrate or nitrite, since we ourselves have made many of these compounds in this way. In the third place, they explain the simultaneous formation of sugars and nitrogen compounds in the living plant, for it is known that there is never present sufficient nitrite to react with all the active formaldehyde which is being produced by the aid of the chlorophyll.

FORMATION OF ALKALOIDS.

To turn to the nitrogenous products themselves we have found that when freshly synthesized formaldehyde acts on a nitrite two classes of compounds are formed, namely, amino-acids and nitrogen bases of the type of piperidine, pyridine, pyrrole, glyoxaline, etc. Many of these bases react with the amino-acids; and in our experiments we have found evidence of as many as eight of these complex compounds, although we have not as yet been able to identify them. The condensation of the substituted amino-acids to give a protein is but one stage further, and here again we have some evidence that bodies of greater complexity than the substituted amino-acids can be synthesized in the laboratory by the action of light, starting from carbon dioxide, water, and a nitrite or nitrate.

Those nitrogen bases which do not condense with the amino-acids combine with more formaldehyde to form complex bodies of alkaloidal nature, and I am inclined to believe that the alkaloids are produced from those bases which have not the power of condensing with the amino-acids. They form the final end-products of the bases which are rejected in the direct protein synthesis. . . . . . .

I have done my best to be as lucid as the subject allows me; and I trust, too, with all my heart that I am as modest as Dr. BENJAMIN FRANKLIN could have wished when I say that we claim to have achieved little beyond a simplification. The production of active formaldehyde, sugars, starches, celluloses, amino-acids, proteins, and alkaloids is merely a question of energy. When the right amount of energy is given to carbonic acid, it is converted into active formaldehyde and oxygen, the latter being transpired into the air again. The former, in the presence of small quantities of a nitrite, reacts to give all the above compounds, every stage of the synthesis being accompanied by a loss of energy. Each separate series of reactions is one of most attractive simplicity, there being no

need for the use of condensing agents which are the tools of the organic chemist when he is synthesizing his more complex compounds. The function of these tools is to supply the energy necessary to activate his re-actant molecules, and since the whole of the energy in the case of the plant is gained from sunlight in the very first step, namely, the formation of the active formaldehyde from the carbonic acid by the agency of the chlorophyll, the need of agents to supply energy at any later stage vanishes. Although these results in themselves may mark an advance, it is the simplicity of the whole that seems to be so important, for it leads one to believe that the vital processes of the higher animals are equally simple; and so, perhaps, it may be that the chemistry of their derangement or disease is simple, too.

Recent Work in Cane Agriculture.

REPORT OF THE COMMITTEE ON CULTIVATION AND FERTILIZATION ON UN-IRRIGATED PLANTATIONS. *Hawaiian Sugar Planters' Association. September 30th, 1922.*

This report, like its predecessor last year, consists of a number of letters from managers of unirrigated sugar estates in the Hawaiian Islands, in reply to a circular letter addressed to them by the chairman of the Committee. These letters are printed in extenso and indicate the directions in which cultivation and manuring on such estates are altering, the chairman leading off with an account from the "Scotch Coast" of the island of Hawaii, presumably where his own estates are situated. Last year's report was reviewed in some detail,[1] and this year a more complete review is given, instead, of the changes taking place in the methods of irrigation and cultivation on irrigated plantations in the islands, and this will be found on another page of this number of the Journal.

REPORT OF THE COMMITTEE ON FORESTRY. *Hawaiian Sugar Planters' Association. September 30th, 1922.*

The natural result of the acute shortage of labour in the Hawaiian Islands has been an enforced curtailment of work on all projects not intimately connected with the handling of the sugar crop. But, although the Report on Forestry work on the estates is short, this does not imply that no work is being done. "Many estates have found it possible to participate in the planting of trees on the water-sheds from which their water supply is obtained, and several plantations have been able to plant out a considerable number of trees for the production of fuel and as windbreaks." On the watersheds 100,000 trees have been planted in Oahu, 60,000 in Hawaii, 50,000 in Maui and 6000 in Kauai. This is the work both of individual plantations and of several working together. Emphasis is however laid on the fact that there are still large areas on important watersheds as yet untouched, and an appeal is sent out by the Committee for the organization of projects for reafforesting these through contributions from the various estates which would benefit by them. Interesting details are given by PENHALLOW as to the forest problems confronting the Waikulu Sugar Company in Maui, of which he is the manager, and his remarks are illustrated by telling photographs of the mountain slopes there. A few additional observations are supplied by the managers of other estates.

[1] *I.S.J.*, 1922, pp. 422-423.

REPORT OF THE PORTO RICO AGRICULTURAL EXPERIMENT STATION. 1921. *Washington, Government Printing Office, 1922.*

The Agronomist in charge, D. W. MAY, draws attention to the fact that the population in Porto Rico is 377·8 to the square mile, thus showing that the island is amongst the most densely inhabited regions of the world. There are, moreover, no large cities and the people depend principally on agriculture for a livelihood. The island is very favourably situated, as it is one of the best markets of the large eastern cities in the United States, has a low freight and no Customs duty. Sugar occupies a dominant position and, with a fall in prices from 24 to 4 cents per lb. within twelve months, serious conditions have developed. Little attention was paid to other crops when the price of sugar was high, and planting was extended to lands which cannot grow sugar economically in normal times. The increase in wages, while benefiting the labouring classes, has hit the plantation owners very severely, most of them having to face the problem of handling the crop at a value below the cost of production. The sudden change will doubtless be of ultimate use to the island, where diversified agriculture should be of special value because of its favourable situation. Much of the land now under sugar cane will inevitably revert to pasture, and a forced rotation should result in providing food for the large population. It is suggested that the sugar farmers should continue to seek for high yielding varieties of cane which are immune to the prevailing diseases, plant legumes which will lessen the cost of fertilizers, practise a system of rotation and use better methods of cultivation with up-to-date machinery to counter the growing cost of labour. There are evidences that such improvements are being introduced, and it is satisfactory to learn that mosaic disease has become less threatening, partly, may be, owing to the disease having run its course and partly to the increased growing of apparently immune varieties of cane.

At the Station, the major experimental work was confined to the breeding of new varieties of cane, demonstrating the value of cultivators, especially of the disc type, and the rotation of canes with legumes. Continued work is being carried on by the entomologists with the object of determining the mode of transmission of mosaic. A considerable outbreak of the yellow plant louse, *Sipha flava*, which occurred to such an extent as to stunt the canes in the field, and especially in the Uba cane, was taken as an opportunity for thoroughly studying the possibility of that insect being responsible for the spread of mosaic, but, as heretofore, no definite results have been obtained.

THE PRINCIPAL VARIETIES OF SUGAR CANE UNDER CULTIVATION IN BRITISH GUIANA DURING 1922. *The Journal of the Board of Agriculture of British Guiana. Vol. XV, No. 3, July, 1922.*

The area under sugar cane in British Guiana continues to decrease, the numbers of acres in cultivation during the past five years having been, 78,223, 73,814, 67,488, 65,869 and 60,596 successively. On the last-named area the following were the kinds of cane grown during 1922 on more than one thousand acres: D 625 37,707 acres, Bourbon 1609, D 625 mixed with Bourbon and other seedlings 6819, D 145 4601, D 118 2573, B 208 1919, and D 419 1007. Of these D 125 shows an increase while all the others have decreased. The total percentage area under D 125 increased from 56·5 last year to 62·2 in 1922; the older varieties taken together diminished from 8·8 to 8·5, Barbados seedlings from 4·4 to 4·3, and Java seedlings from 1·1 to 0·4. British Guiana seedlings now cover 86·8 per cent. of the cane fields. Of the varieties enumerated above the average yields in 1922 were, for D 125 2·06, Bourbon 2·10, D 145 1·94, D 118 1·79, B 208 2·11, and D 419 1·87 tons of sugar per acre.

Recent Work in Cane Agriculture.

EEN NOG NEIT ALS PLAG VOOR HET SUIKERRIET BESCHREVEN SLAKRUPS (LIMACODIDA). (A SLUG-CATERPILLAR NOT HITHERTO DESCRIBED AS A PEST IN JAVA CANE FIELDS.) *J. Kuyper. Mededeelingen van het Proefstation voor de Java-Suikerindustrie. 1922, No. 11.*

This new pest was first reported in the cane fields of Garoem estate as causing a considerable amount of damage as a leaf eater. It belongs to the Limacodidae, the caterpillars of which are armed with stinging hairs which cause intense irritation and swelling of the glands due to the injection of formic acid. It occurs chiefly in portions of the fields where dense masses of leaves are formed and is usually found on the lower leaves in damp places. The damage to the fields is caused less by the actual leaf destruction than by the unwillingness of the cane cutters to work in them. It has been noted in the cane fields before, but this is the first time that it has attained to the rank of a pest, and the best means of overcoming it is by burning. But burning the fields before cutting will inevitably destroy the tops of the canes, and this loss of seed material may be serious. The eggs are laid on the leaf blade or lamina and, in any case, the trash should be destroyed after harvesting the cane and the ground dug over to bury the cocoons deeply in it. The pest has been recognized as a species of Thosea, and at least two natural parasites have been bred from it, one a large Tachinid fly and the other a Chalcidid wasp. These parasites are credited with keeping the pest in check normally, and it is regarded by the author as probable that no great increase is likely, as it has been known for some time, and that the balance of nature will be quickly restored by means of its enemies. It is known locally as *oelar lintang*, and the paper contains illustrations of its various stages.

ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE IN JAMAICA FOR THE YEAR 1921.

The year under report was, agriculturally, one of good rainfall well distributed, 84 ins. having fallen, or seven above the average. In spite of this, however, the effect of the great drought of the previous year could be distinctly traced. Commercially, the year was one of grave difficulty, and every producer experienced a serious set-back. The position is fairly summarized by the figures of total export. In 1920, a year of poor production, the exports were valued at £7,146,000, while in 1921, a year of good production, they only reached £3,358,000. Heavy losses were incurred by sugar planters, especially those progressive ones who had invested money in agricultural enterprise, and, but for the prompt action of the Legislature, a serious crisis accompanied by much suffering would have supervened. Happily, according to the writer of the Report, things have materially improved, and the position on the island is not so bad as on some of the other British West Indian islands. The drought of 1920 was reflected in the sugar exports of 1921 when there was a fall of some 8000 tons, to only 26,000. Of this sugar, 55 per cent. was sent to Canada and 41 per cent. to the United Kingdom, as the result of preferential treatment. The position of the rum industry appears to be extremely unsatisfactory, greater quantities being produced by the enlarged central factories but of a poorer quality, because of the better methods adopted in the manufacture of sugar and the more rapid fermentation employed. At present some 8000 puncheons are laid by, which cannot be sold at any price. All this has reacted disadvantageously on advances in cultivation, the control of mosaic and the experiments on varieties of cane. We note also that the posts of Assistant Director, Government Botanist, Micro-bacteriologist, and Deputy Island Chemist are still vacant.

The distribution of seed cane was large during the year. Although two nurseries were closed down because of absence of demand resulting from the non-erection of proposed factories, the total number of sets distributed was greater even than in 1919-20. At Hope nursery a new record was established, 141,547 sets being distributed, but we note that of these 130,550 were of the Uba variety. This cane appears to be making good in Jamaica and is proving of great value in the feeding of dairy stock, being readily eaten when mixed with a little cotton seed. In the drier parts of the island its cultivation is also extending for sugar making. It is regarded as "a useful stand-by in poor years for making up the tonnage of fields in dry districts under unfavourable conditions, although it is inconvenient to reap because of the clinging trash and the great number of small canes." At Hope nursery a plot of 2 acres produced 74 tons of cane and 10 of tops per acre, and in the dry part of the island the yield of canes, although of course much less, was in cases given distinctly superior to that of the locally grown kinds.

Mosaic appears thoroughly to permeate the island, the Hope garden being stated to be the only place from which the disease has been completely eradicated. In one place it has been thought worth while to pay one farthing to one half-penny for each affected stool which is removed from the fields. Although, where the infestation is heavy, this is rather expensive it is generally regarded as economical in the long run. It is claimed that the systematic roguing is producing a good effect wherever tried. The manurial experiments were largely unproductive because of the drought conditions, and comparatively few deductions can be drawn from the results. The series included tests with ammonium sulphate, nitrate of soda and sulphate of potash in various combinations, pen manure, lime, and the local (?) practice of giving each stool a quart of ashes. Phosphatic manures were excluded because of not having given any results on previous occasions. A more extended series is proposed during the current year when the conditions should be more favourable. The work of the Entomologist does not appear to indicate that there are any serious pests in the cane fields.

C.A.B.

Hawaiian Practice in the Clarification of Cane Juice by Liming.[1]

By WILL R. McALLEP

Increased interest has been taken in Hawaii during the last season or two in the clarification of cane juice, and modifications of the former practice in the process of liming have been tried in many factories. The great part of this new work has been in the direction of carrying a higher alkalinity, but experiments have also been made on the value of the method of adding lime at the mill, and also of returning the settling and press cake to this point. For the purpose of preparing a summary of the results secured, the writer addressed letters to the different plantations inquiring what had been done along these three lines. Twenty-seven replies were received, four of which stated that no experiments at all had been made. Though much of the material in these letters is very interesting, publication in full will unduly lengthen this report.[2]

[1] Abridgment of a report presented to the Committee on the Manufacture of Sugar and Utilization of By-Products, appointed by the Hawaiian Sugar Planters' Association.

[2] Abstracts of a few replies only are here reproduced.

A More Alkaline Clarification.

First an abstract of some of the replies relating to the value of a more alkaline clarification will be given.

Wailuku.—Clarified juice is now more alkaline to litmus than formerly. As a result a larger increase in purity from mixed juice to syrup, better work at filter-presses, and no trouble in evaporation.

Onomea.—Amount of lime is now increased 43 per cent; whereas previously the least amount that would give a good clarification, that is between slight acidity and neutrality to litmus, was used. Now the reaction lies between litmus and phenolphthalein neutrality. Increase in purity is now larger, amount of mud slightly greater, no trouble with scale or in boiling, and a better recovery. Trouble with caked sugar has so far disappeared.

Pioneer.—Formerly neutral clarified juice; now a distinct alkalinity to phenolphthalein in the cold mixed juice, the increased lime consumption being 20 per cent. A better clarification, larger increase in purity from mixed juice to syrup, larger amount of settlings to filter-presses (and a slightly larger loss at this station) have resulted. No difference in scale or in boiling; no difference in molasses purity; and a reduction in the undetermined loss.

Pepeekeo.—Clarified juice maintained between slight acidity and neutrality to phenolphthalein. This gives largest increases in purity and best settling. The writer would note that this represents a comparatively strong alkalinity to litmus.

Hawaiian Commercial and Sugar Company.—Lime increased from 2·78 to 3·36 lbs. per ton of cane. Increase in purity, 0·67 as compared with the previous crop.

Paauhau.—Previously, clarified juice was neutral to litmus; but now sufficiently alkaline to give a syrup alkaline to litmus. This is still the practice; but heavier liming than this caused slower boiling and slower drying of the low grade massecuite.

Hakalau.—Clarification, neutral or slightly alkaline to litmus. A short trial of increasing the lime resulted in a slow settling and cloudy juice, and the experiment was discontinued on account of limited clarifier capacity.

Ewa.—Clarified juice is alkaline to litmus. Increasing to alkalinity to phenolphthalein in raw juice caused settling and filtering difficulties. A third larger settling capacity and 25 per cent. increase in filtering area would be required.

Olaa.—Clarification is carried alkaline to litmus. During two weeks' trial lime was gradually increased to about 30 per cent. more than was formerly used without, however, arriving at an alkaline reaction to phenolphthalein in cold mixed juice. Settling was not improved and the increase in purity dropped from 1·7 to 1·5. The experiment was discontinued because of the bad effect on the boiling and drying low grades.

Of 24 factories giving data on this subject, 16 report that a more alkaline clarification than formerly is now the practice. Of these 16, 11 mention larger increases in purity from mixed juice to syrup, and 4 have noted decreases in the undetermined loss. One has found better press work, while 4 give increases in the amount of mud. None of the 16 reports trouble in settling; while 7 say that the clarification is either satisfactory or better. Nor do any state there was any serious difficulty in the boiling-house as a result of conducting a more alkaline clarification than formerly.

One factory only employed a less alkaline clarification, made necessary by an increased grinding rate without an increase in either settling or filter-press capacity. Three discontinued experiments with a more alkaline clarification, because settling and filter-press capacities were insufficient so to operate. Results considered unfavourable were secured at the remaining two factories. At one where the clarification was already alkaline to litmus, no further increase in purity was secured, and trouble was encountered in the boiling and in drying low

grade massecuite. At the other factory, where the clarification was neutral to litmus, the increase in purity was not improved by using more lime; and there was trouble on account of scale in the evaporators and pans, and the slower boiling of the low grade. In this case, however, the drying in the centrifugals was not affected.

The fact that 16 out of the 22 factories reporting experiments with the use of an increased amount of lime now carry the clarification at a more alkaline reaction than formerly, tends to confirm our opinion based on experimental work that, on the whole, the quantity of lime used in clarification in Hawaiian factories has not been large enough to secure the best results. Our suggestion to control the clarification by liming the cold mixed juice to phenolphthalein neutrality has not apparently, been so widely adopted. A number of factories have carried clarification at a reaction sufficiently alkaline to secure syrup alkaline to litmus, with satisfactory results, but on increasing the lime to phenolphthalein neutrality in the cold juice these have encountered the difficulties characteristic of the use of an excessive amount of lime.

On the whole the results have indicated that no difficulty will be encountered if the clarification is controlled as suggested. Reasons of failures may be as follows: Addition of lime at the filter-presses may, in some cases, be responsible for over-liming and a defective method. A second possible cause is the method of controlling the clarification often followed: The addition of a fixed amount of lime to each tank of juice is ordered to be made, the amount being controlled by tests made from time to time by the sugar boiler. But the lime requirement of juices from different canes varies so greatly that the writer considers it probable that in practice when operating in this way a sufficient amount of juice will be heavily over-limed to cause difficulty when the full lime requirement of the juice is approximated. A more practicable method is to require the man doing the liming to carry the juice at the desired reaction. Then a third cause of trouble may have been failure to neutralize the phenolphthalein solution used for testing the juice. It is, of course, possible that some juices will be found that will be over-limed at phenolphthalein neutrality in the cold juice.

At the risk of repetition the writer would note that a more alkaline clarification will result in a larger volume of settlings and also a slightly greater amount of solids in the press-cake, both of these characteristics increasing the work required of the presses. With respect to the rate of settling, however, the writer has so far observed little indicating that the more alkaline juices settle slower than those less alkaline in reaction. It is probable that opinions are expressed to this effect because the settlings occupy a greater, frequently a much greater, volume in the more alkaline juices.

The ill results of using too much lime are obvious and the danger is well understood. The results of using too little lime, however, are not so obvious, and the danger of inversion is not so generally appreciated. It is obvious that the reaction should not be carried to a point sufficiently alkaline for lime to have a destructive action on the glucose and probably other organic compounds, but liming is often stopped far short of this point and indeed at a point where our investigations have detected inversion because of difficulties due to overloaded filter-presses, the necessity of removing an increased amount of scale from heating surfaces, or indeed on purely theoretical considerations. In such cases the less obvious losses due to the inversion of sugar, and failure to secure the possible increase in purity from mixed juice to syrup, probably far outweigh the cost of overcoming the more obvious difficulties just mentioned.

Adding Lime at the Mill.

Information on this subject has been furnished from 11 factories. These data in condensed form follow.[1]

Hilo.—Lime has been added at the mill throughout the 1921 and 1922 seasons. It is important to control the quantity used. If too much is applied much of it will be lost in the bagasse, the mixed juice may become alkaline, a condition not favourable for controlling the clarification, and the rollers will slip. The quantity used should be controlled by keeping the last mill juice at about the same alkalinity as the clarified juice; that is, it should be distinctly blue to litmus, but not red to phenolphthalein. The diluted juices used as maceration become alkaline. Mill beds, flumes, etc., can be kept cleaner as there is less slime to contend with and no unfavourable results have been detected. It is being continued here as a regular practice.

Waialua.—Favourable effects were a tendency to prevent deterioration around the mills, juice pans, tanks and flumes, and an unfavourable effect was the polishing of the rollers, causing decreased tonnage. It pays to add lime at the mill, but it demands close supervision. It is not used here at present.

Ewa.—It did not seem to make any difference where lime was applied, whether at the mill or at the juice scales. About one-third more lime was necessary when liming at the mill.

Koloa.—A trial of short duration was made several years ago. No favourable results were secured, and it was noticed that discoloration of the juice was more pronounced than before. The work of the mill was apparently not affected.

Onomea.—During 1921 we tried liming juices at the mill. We did not get the anticipated results. Quite a lot of lime was lost in the bagasse, and the experiment was discontinued after two weeks. The extraction was not affected and the ratio of mixed to first expressed juice purity was the same as before.

Pioneer.—We tried liming at the fifth, fourth, third and second mills. No favourable results were noted. Disadvantages were the extra lime carried away by the bagasse and the difficulty of getting a continuously uniform liming, especially when grinding canes from different fields, or if the mill had to be stopped or slowed down for a few minutes. Clarification was so irregular that we gave up the experiment without trying a full week's run at any one mill, so we are not absolutely sure of the relative juice purities, but there were no indications of a change either favourable or otherwise. The process could probably be worked out to give nearly as uniform liming as we now get at the settling tanks, but one cannot see any particular advantage from it. Enough lime to give any antiseptic action at the mill would be too much for clarification. *Leuconostoc* fermentation would be favoured and there would be more chance of dissolving gums from the bagasse.

Adding lime continuously at the mill has been tried at 10 of the above factories. It is continued as a part of the regular routine at 1 only, though the practice is approved at 2 others. It is not practised at one of the latter because it disturbs the regular liming of the juice at the scales, while at the other the observation is made that it requires close supervision. At 4 factories the results were indifferent, no particular benefit being noted to offset the increased lime consumption and the increased difficulty of maintaining the clarification at an even reaction. At 3 factories, deleterious effects were noted: a decrease in extraction, slippage in the mill, a low mixed juice purity, and difficulties with boiling and crystallization even in the commercial sugar massecuites.

From the above it seems that the continuous addition of lime at the mill has not been particularly successful in practice. In so working it is inevitable that some insoluble impurities will be extracted from the bagasse by the alkaline juices. As noted in the report from Pioneer, lime cannot be added in sufficient quantities to prevent bacterial growth. However, the neutralization or partial

[1] Here also only a few replies are abstracted.

neutralization of the juices used for maceration will reduce chemical inversion due to acidity. So far as the writer is aware, the extent to which such inversion takes place and the extent to which the juices can be neutralized without extracting impurities from the bagasse, has not been investigated.

Particular attention is called to the reduction in the difference between crusher and mixed juice purities secured at the Hawaiian Agricultural Company's mill and at Paauhau, largely as a result of spraying the mill intermittently with milk-of-lime. Figures for this difference being for 1921 and 1922 as follows:

	1921.	1922.
Hawaiian Agricultural Co.	2·86	2·17
Paauhau	5·10	3·80

If these results can be duplicated at other mills, the practice is most promising. Theoretically also the practice is sound. If lime is sprayed on with an apparatus such as a whitewash sprayer it can probably be applied in concentrations toxic to bacteria, particularly in such places as mill cheeks, parts of the juice pans and other places where a comparatively small quantity of juice splashes without using enough to endanger extracting insoluble matter from the bagasse. If lime in toxic concentration actually reaches places such as these, that are not subject to the scouring action of a flow of juice, once in an hour or even once in two hours, bacterial growth around the mill, except for that which takes place in the juice strainers, will be practically nil.

RETURN OF SETTLINGS OR OF PRESS CAKE TO THE MILL.

Three factories have reported the results of experiments along this line and summaries of their statements are as follows:

Waialua.—We were able to return to the mill on the average, settlings corresponding to about 10 tons of mud a day without any material effect on mill or clarification. Any slight increase in the mud returned, however, made the clarification very sensitive.

Paauhau.—Settlings from the clarified juice were added in front of the third mill. Mixed juice was limed as usual. The first clarifier did not clarify as well as the regular juice. It contained a lot of fine suspended matter with a slight red coloration. The other four clarifiers also stood one hour and on opening them it was found that practically no clarification had taken place.

Waiakea.—Diluted mud from the first presses was added to the last mill juice. A considerable proportion of the mud re-entered the mixed juice and retarded the settling to such an extent that the proportion of clear juice was greatly lessened, and a largely increased quantity of mud had to be handled by the first presses. So great was the congestion at these two stations, that the experiment had to be discontinued. Bagasse samples indicate that the extraction would have suffered somewhat had the procedure been continued. The principal reason for the failure of the experiment was that a large proportion of the mud once removed from the clarified juice found its way back into the mixed juice resulting in an ever increasing volume of mud in the settling tanks. The bagasse blanket of one mill did not constitute a proper filtering medium.

The return of settlings to the mill has been practised in at least two other factories, Lihue and Kahuku, though the results of these experiments have not been reported. At Lihue all the mud was returned for the last six weeks of the season. Inspection of the weekly mill report figures shows a steady decrease in extraction during this period, this finally dropping two points below what it had been at the beginning of the experiment. At Kahuku the whole of the settlings was not returned. Here also the figures in the weekly mill report seem to indicate a decrease in extraction. It has been the general opinion that returning settlings to the mill causes a decrease in the extraction as a whole. The above results tend to confirm this belief.

Department of Overseas Trade Reports.

FORMOSA SUGAR CROP.

His Majesty's Consul at Tamsui (Mr. G. H. PHIPPS) reports that the second official forecast of the sugar crop of Formosa for the 1922-23 season estimates the total production as follows:—

	Piculs.
Centrifugals	5,212,503
Browns..	1,211,181
	6,423,684 [382,362 long tons.]

The production of centrifugals in 1921-22 amounted to 5,860,000 piculs, so that the figures quoted for centrifugals above would show a decrease of 650,000 piculs as compared with the previous year. Another more optimistic estimate places the total production of centrifugals at over 5½ million piculs, but the real figure is more likely to be under than above the official estimate.

The first official forecast in July estimated the production of centrifugals at from 4,800,000 to 5,000,000 piculs. The second investigation, in November, showed an area planted with sugar for modern mills of 110,000 "ko" (288,750 acres), a decrease of 20,000 "ko" (52,500 acres) as compared with 1921. Crops were good owing to the abandonment to other purposes of land where the yield of sugar was bad, as well as to comparative immunity from typhoons and freedom from insect pests, and taking an average of 500 piculs of raw sugar per "ko," this gave a total of over 55,000,000 piculs of raw sugar for the year. The average sugar content being 9·8 per cent., this calculation would bring the production of refined sugar to 5,390,000 piculs [320,833 long tons]. Reports received from the factories are however said to be to the effect that the sugar content this season is low, reaching only about 8·5 per cent., so that unless a considerable improvement be shown, the above total of 5,390,000 piculs would in that case have to be reduced by about 10 per cent. to a figure of some 4,800,000 piculs [285,714 tons].

The prospects of the sugar industry in Formosa, with its high costs of production, are none too rosy at present. It is accordingly of the highest importance that costs should be reduced, and with this end in view the companies have been rigorously cutting down staffs, suspending orders for new equipment and effecting other economies. Newspaper reports state that costs of production in 1922 were as a result reduced from 17-25 yen to 12-15 yen per picul and that in 1923 it is hoped to reduce this further still to as low as 8 or 9 yen in South Formosa and to about 11 or 12 yen in the Centre and North of the island.

BELGIUM.

The area sown with sugar beet in 1922 was some 160,000 acres, or 12 per cent. more than in 1921. The weather conditions for the growth of the roots were favourable, and as regards weight the yield was good, averaging 10 tons to the acre. The richness in sugar content varied somewhat, but the mean is estimated at about 17 to 17½ per cent. The sale price to the factories was 135 francs per ton delivered at the factory. The campaign, which was finished by the beginning of December, was a matter of some concern, for there was a scarcity of labour, due to French competition. Heavy rains also interfered with the operations. Some damage was caused by frost to roots delivered at the factories.

There is an agitation in favour of securing protection for this industry, it being maintained that otherwise Belgian sugar growers will be ruined by the competition of the protected growers in America, Italy, France, Czecho-Slovakia, and other producing countries. It is pointed out that many railway lines, which derive large profits from the transport of sugar beet, would be equally affected, and that the higher price of sugar to the consumer—the average, annual *per capita* consumption being only 12 kgs. (26½ lbs.)—would be extremely small.

Publications Received.

Beiträge zur Geschichte der Naturwissenschaften und der der Technik. By Prof. Dr. Edmund O. von Lippmann. (Verlag von Julius Springer, Berlin.) 1923. Price: 7s. 11d. (bound).

Prof. VON LIPPMANN is able to find time, in addition to that demanded by his duties as manager of the important sugar refinery at Halle, for an immense amount of literary work, such as articles in the technical press, a review of the progress of the chemistry of the sugars, and not least the publication of books dealing mainly with the history of chemistry, which latter alone must involve a considerable amount of research. Thus, besides his well-known works on the history of the sugar industry and on the chemistry of the sugars, he has written on the history of natural science and on that of alchemy, and recently issued a chronological table relating to organic chemistry.[1] This volume before us is a collection of 36 essays dealing with the history of natural science and technology, originally published in certain periodicals, the subjects selected covering a wide range. There are, for example, readings on the history of alchemy, of the determination of specific gravity, of alcohol, of the vacuum apparatus, and of continuous cooling and distillation; while under other headings are found contributions on the mediæval sugar industry, sugar monopolies in the middle ages, letters of Achard, and Goethe's connexion with the sugar industry. A most absorbing and also a very profitable diversion with which the chemist may occupy himself is the investigation of the gradual development of the main phases of his science from their earliest stages. A book like this incites one to such a study; and there can be no doubt that its interest and value will be much appreciated.

Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists. Compiled by the Committee on Revision of Methods, R. E. Doolittle, Chairman. (Association of Official Agricultural Chemists, Washington, D.C.)

The most cursory perusal of this well compiled volume will convince the reader that a vast amount of detailed work has been called for in the evolution of such a collection of analytical methods. While being models of conciseness, the descriptions of procedure omit no details necessary for the proper carrying out of the determinations, and the individual processes are as nearly "fool proof" as it is possible to make them. While primarily intended for the use of chemists engaged in agricultural work, the actual scope of the volume goes far beyond this; and chemists engaged in the examination of foods and drugs, for example, will find the sections dealing with these branches of analytical practice of great value for the purpose of reference. Considerations of space do not allow of the various sections being reviewed in detail, and where all are so good it would be invidious to select any particular section for special praise, that dealing with saccharine products for example. To the individual chemist the great test of value is the usefulness of such a volume in his daily practice; and judged by this criterion in the reviewer's experience the volume occupies a very high position as a work of reference. Great credit is due to all concerned in the production of this very useful collection of methods of analysis.

Alcohol for Industrial Purposes. (U.S. Industrial Alcohol Co., 27, William Street, New York, U.S.A.) 1923.

A booklet of 32 pages listing specifications and formulas for completely and specially denatured alcohol, together with specifications for those materials used as denaturants in all formulas. The uses for which special formulas have been issued as well as the technique of securing the necessary permits for their use are described in detail.

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[1] *I.S.J.*, 1921, 695.

Brevities.

The sugar producers in Czecho-Slovakia have recently formed a Cartel to determine each member's share of domestic sales and fix domestic prices to wholesalers. All surplus sugar over such allotment must be disposed of outside the country, but, that apart, its sale to foreign buyers is outside the jurisdiction of the Cartel.

Regarding the recent installation of the Petree process, Mr. JOHN WATERHOUSE of Alexander & Baldwin, agents for the Maui Agricultural Co. and the Hawaiian Commercial & Sugar Co., expressed satisfaction with the preliminary results obtained, stating that "in general the process is working smoothly, and I am well satisfied with it."

During 1919 the exports of refined sugar which have been made from the port of New York to Great Britain amounted to 4,042,581 bags of 100 lbs. (180,472 long tons). Shipments to London amounted to 1,114,091 bags; to Hull, 525,885; to Liverpool, 405,546; to Newcastle, 299,330; to Glasgow, 140,350, and to Cardiff, 156,156. As to the total quantity exported during the year, this amounted to 12,933,662 bags.[1]

In a patent recently taken out by TETSUO and the TAIWAN SEITO KABUSHIKI KAISHA,[2] claim is made for the following procedure by which (it is stated) inversion is prevented and the yield of sucrose is increased. The juice is mixed with 0·01 to 0·001 per cent. of 30 per cent. formaldehyde solution, and 0·1 to 0·5 per cent. of 96 per cent. alcohol, agitated, and boiled for 15 mins. After a few hours, it is separated from the precipitate, concentrated, and crystallized as usual.

A new formula (No. 28–A) for the marketing of alcohol for use as a motor fuel has been approved by the prohibition unit of the U. S. Treasury Department, and approved by the Commissioner of Inland Revenue,[3] being as follows: To every 100 gallon of ethyl alcohol of not less than 198° proof, add 1 gallon of gasolene. The gasolene used must comply with a certain test in respect of volatility and distillation range, and the blending must be done at the point of manufacture.

In the manufacture of table syrup in Louisiana, it has been found that applications of "Darco" decolorizing carbon at the rate of about 1 oz. per 100 lbs. of juice direct from the mill (without sulphuring, liming, but only by passage through closely woven, flannel cloths for the removal of the particles of carbon, gums, and also *bagacillo*, etc., not brushed off in the blanket of scums) produce a brilliantly clear juice, and on evaporation a deliciously mild, sweet syrup. Other notable qualities of syrup thus made are its perfect clarity and golden glister, and a marked decreased tendency to ferment.

References have appeared in the New York press to plans for the fusion of large sugar interests in Cuba; it is asserted that a Syndicate having a capital of $100,000,000 is contemplated. The parties mentioned as being concerned in the venture include the National City Bank of New York, and the Guaranty Trust Company, while at the Cuban end, the Cuban-American Sugar Company, the National Sugar Company and some other big operating concerns are involved. This news if accurate only goes to confirm the reports prevalent last year that the banks and the refiners are trying to get a controlling hold of Cuban sugar.

RAY NELSON,[4] of the Michigan Agricultural College, states that the cause of the mosaic disease of potatoes is infection by protozoa very similar in type to trypanosomes causing African sleeping sickness. It was previously believe that this mosaic disease was due to filtrable viruses; but, by cutting stems lengthwise, flagellates that attack the nucleus of the cell are said to have been revealed. Regarding the mosaic diseases of corn and wheat, these are said by Dr. L. O. KUNKEL, of the Hawaiian Agricultural Station, and H. H. MCKINNEY, of Wisconsin, to be due to amœbæ somewhat like the organisms causing malaria and yellow fever. These parasites are carried by insects from diseased to healthy plants, and are communicated from generation to generation by diseased seed. Pure seed and insect eradication are the protective measures necessary.

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[1] *Facts about Sugar*, 1923, 16, No. 4, 64.

[2] Japanese Patent, 39,609 of August 19th, 1921; through *Chemical Abstracts*, 1922, 16, No. 18, 3229.

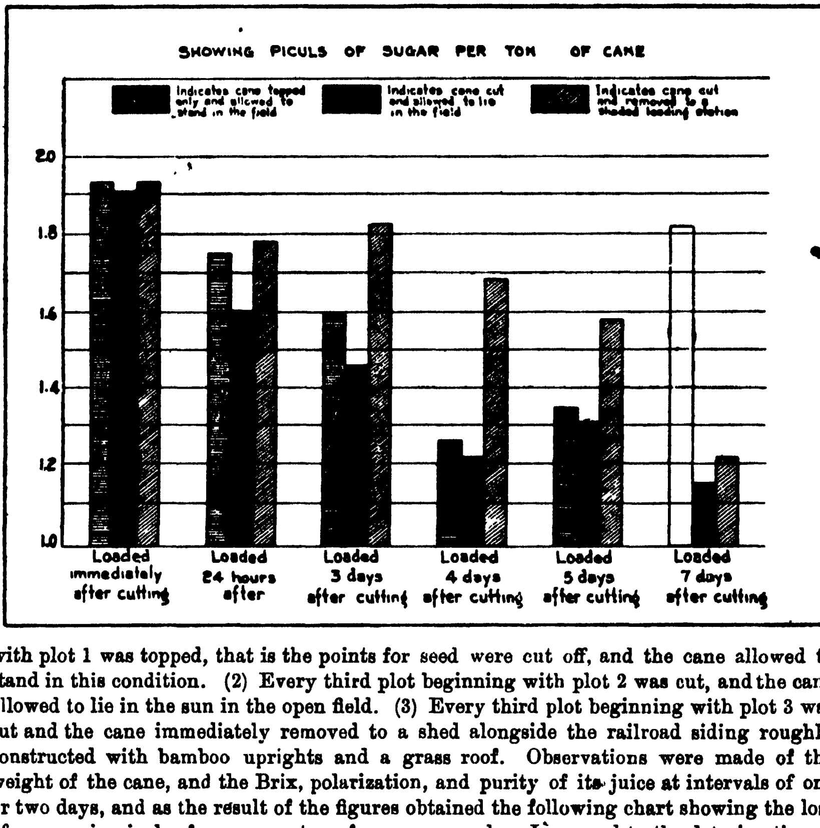
[3] *Chemical and Metallurgical Engineering*, 1923, January 3rd.

[4] *Science Service*, December 29th, 1922.

Review of Current Technical Literature.[1]

DETERIORATION OF CUT CANE IN PAMPANGA (P. I.), AND THE VALUE OF A LOADING SHED IN DIMINISHING THE LOSS OF SUCROSE. *Anon.*[2] *Sugar News*, *1923*, *4*, *No. 1*, *7-15*.

As the result of investigations carried out in different countries,[3] it is now a generally accepted fact that the cane after having been cut deteriorates with rapidity, the amount of sucrose lost owing to inversion reaching under certain conditions a very high figure. In order to demonstrate to the planters of the Philippine Islands the danger of delay in dealing with cut cane, a field of the Papanga Red variety was divided into 90 plots (each containing nearly half a ton), and treated as follows: (1) Every third plot beginning



with plot 1 was topped, that is the points for seed were cut off, and the cane allowed to stand in this condition. (2) Every third plot beginning with plot 2 was cut, and the cane allowed to lie in the sun in the open field. (3) Every third plot beginning with plot 3 was cut and the cane immediately removed to a shed alongside the railroad siding roughly constructed with bamboo uprights and a grass roof. Observations were made of the weight of the cane, and the Brix, polarization, and purity of its juice at intervals of one or two days, and as the result of the figures obtained the following chart showing the loss of sucrose in piculs of sugar per ton of cane was made. In regard to the deterioration of topped cane, it was shown that after it has stood for four days before cutting and milling a loss of two-thirds of a picul of sugar is experienced. Out cane which is allowed to lie in the sun in the open field suffers the greatest loss, as one would expect, and financially this practice is most reprehensible, But in the case of the cane which was dumped in the shade of the bamboo and grass erection the loss was much less than under the previous two conditions, proving that the use of such a loading shed has a distinct value, and yields a very large return on the small investment incurred. Recording thermometers placed inside

[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*, 298.

[2] Experiments conducted under the direction of the Investigations Staff of the Bureau of Science, Philippine Sugar Centrals' Agency, San Carlos Milling Co., North Negros Sugar Co., Victorias Milling Co., and Hawaiian-Philippine Co. [3] *I.S.J.*, 1920, 64; 1922, 100.

and outside the loading shed showed a difference as great as 20° F., which difference of temperature would seem to exert a very great influence on the deterioration. A further advantage is that it makes conditions more favourable for loading, the lower temperature being better appreciated by the workers engaged in this rather arduous task.

PROPORTION OF SUGAR DUE TO THE PLANTER IN PAYMENT OF HIS CANE. *A. W. Woods.* *Sugar News, 1922, 3, No. 6, 260-263.*

Mr. R. C. PITCAIRN[1] has described the method of calculating the distribution of sugar to *hacenderos* as practised by the Hawaiian Philippine Co., in which two constants known respectively as C and D are determined. In regard to this method, it is remarked by Mr. WOODS that the numerous computations required hinder its convenience for routine application, and so with the help of Mr. JOHN J. RIEHL he has condensed and simplified it in the following way. First, the following nomenclature has been adopted: A = day average mixed juice gravity purity; B = day average crusher juice apparent purity; C = mixed juice factor for the day (A divided by B); D = purity of crusher juice of any planter's cane; J = gravity purity of mixed juice of any planter's cane; $A/B \times D = C \times D$; M = gravity purity of molasses to date; R = boiling house recovery = $S(CD-M)/CD(S-M)$; P = polarization per cent. cane; N = per cent. polarization in crusher juice; F = Java ratio = P divided by N; E = mill extraction; G = day constant = $E \times F$; H = polarization of crusher juice of any planter's cane; S = gravity purity of sugar manufactured to date; Cl = reciprocal of mixed juice factor for the day = B/A.

Then let X equal the per cent. sucrose available in any planter's cane, and:

$$X = \frac{S(CD-M)}{CD(S-M)} \times \frac{G \times H}{100} = \frac{SCD-SM}{SCD-CDM} \times \frac{G \times H}{100} = \frac{1-\frac{M}{CD}}{1-\frac{M}{S}} \times \frac{G \times H}{100} =$$

$$\frac{S}{S-M}\left(1-\frac{M}{CD}\right)\frac{G \times H}{100} = \frac{SG}{100\,(S-M)}\left(D-\frac{M}{C}\right)\frac{H}{D}$$

Let b = Brix of crusher juice of any planter's cane. Then $\frac{H}{D} = b$; substitute b for $\frac{H}{D}$; and $X = \frac{SG}{100\,(S-M)}\left(D-\frac{M}{C}\right) B.$

Let Cl = the reciprocal of C.

Then $X = \frac{SG}{100\,(S-M)}(D - MCl)\, b$; and $Cl = \frac{B}{A}$. Since $\frac{SG}{100\,(S-M)}$ and MCl are constants for the day, let K equal the first constant and T equal the second, so the formula then reduces to: per cent. available sucrose = $K(D-T)\,B$.

Using this simplified method the procedure is as follows: The day average crusher juice purity B, divided by the day average mixed juice gravity purity A, gives Cl, the reciprocal of the mixed juice factor; this multiplied by the gravity purity of molasses to date, M, gives constant T. The Java ratio, F, multiplied by the mill extraction, E, gives the day constant G, which multiplied by $\frac{S}{100\,(S-M)}$, in which S is the gravity purity of sugar to date, and M the gravity purity of molasses to date, gives the constant K. Taking the Brix b and the purity D of crusher juice of any planter's cane, the per cent. available sucrose equals $K\,(D-T)\,B$, thus reducing the operations to one substraction and two multiplications for each planter. Although multiplying the tons of cane by the per cent. available sucrose gives tons sucrose and not tons of sugar, this is not important, as a factor must be used in the end to change this calculated sucrose or sugar to the actual production as determined by taking stock of the sugar in process and that bagged.

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[1] *I.S.J.*, 1921, 623.

Example: Day average crusher juice purity $B = 90{\cdot}51$; day average mixed juice gravity purity, $A = 89{\cdot}69$; $Cl = \frac{B}{A} = 1{\cdot}0091$; gravity purity molasses to date, $M = 38{\cdot}64$; constant $T = M\,Cl = 38{\cdot}99$; Java ratio, $F = 83{\cdot}08$; mill extraction, $E = 95{\cdot}36$; constant $G = E \times F = 0{\cdot}7923$; gravity purity sugar to date, $S = 97{\cdot}74$. Constant $K = \frac{S}{100\,(S - M)} \times G = 0{\cdot}016538 \times 0{\cdot}7923 = 0{\cdot}013103$.

A study of the following results will show the fairness of this method of distribution between planters having high and low analysis :—

Planter.	Brix, *b*.	Polarization.	Purity.	*D* — *T*.	Per cent Sucrose in Cane.
1	19·79	17·66	89·24	50·25	13·03
2	17·76	15·98	89·98	50·99	11·37
3	20·36	18·90	92·83	53·84	14·36
4	20·96	19·22	91·70	52·71	14·48
5	15·13	13·07	86·38	47·39	9·39
6	16·26	13·95	85·79	46·80	9·97

DETERMINATION OF THE PLANT-FOOD CONSTITUENTS (e.g., PHOSPHORIC ACID) IN CANE JUICE AS A DIRECT INDICATION OF THE FERTILIZER REQUIREMENTS OF THE SOIL. *Herbert Walker.*[1] *Journal of Industrial and Engineering Chemistry, 1923, 15, No. 2, 164-165.*

According to the so-called "physiological" method of soil analysis, the amount of plant food available in a soil is indicated (relatively) by analyses of the mineral matter of crops grown in it. This idea seems a very practical one; but it has not been extensively worked out, and probably one reason for this is the difficulty in getting representative samples and reducing them to the state of ash for the purpose of the analysis. This difficulty was overcome to some extent by BURGESS,[2] who compared the analyses of final molasses from a large number of plantations, and pointed out the fact that "there exists a definite relationship between the percentage of potash present in the soils of a given region and that found in the final molasses from that section." This relationship has been partially confirmed. Though the great majority of field tests made throughout the Hawaiian Islands have shown little or no increased yield of sugar from the application of potash fertilizers, yet the few soils that have responded are from those districts whose final molasses runs much lower than the average in potash. But a serious drawback to the use of molasses analyses for other than very general conclusions is the difficulty of determining from which particular field the samples has been derived. A procedure which would appear to have most of the advantages and few of the disadvantages of plant-ash or molasses-ash analysis is the direct determination of the plant-food constituents in the cane juice obtained in the mill. Samples can readily be obtained from the crusher or first unit during the season, differentiating these according to the fields on which the particular cane undergoing crushing has been grown. Theoretically, this method once properly correlated with fertilizer experiments in the field seems very logical. Instead of trying to imitate nature by extracting soil in the laboratory with weak acids, the cane is allowed to effect its own "soil solution," and submit it ready-made for analysis. That the relative amount of plant food actually taken up is in some degree a measure of its availability seems a reasonable assumption. It has now been put to the test by the writer in collaboration with Mr. G. R. STEWART, of the H. S. P. A. Experiment Station, and Mr. G. B. GLICK, chief chemist of the Pioneer Mill Co., the phosphoric acid in the crusher juices being determined by the uranium acetate method, using potassium ferrocyanide as indicator.[3] Interesting results were obtained. Some preliminary figures demonstrated that while samples from the same field of the Wahikuli section showed very little difference in P_2O_5 content, there were very marked variations in the case of juices

[1] Of the Pioneer Mill Co., Lahaina, T.H. [2] *Hawaiian Planters' Record*, 19, 421.
[3] Described in Sutton's "Volumetric Analysis."

from different parts of the plantation. Thus, in certain fields at three different elevations viz., 50, 200–300, and 800–900 ft., the several analyses from fields on the same elevation were generally about the same, but the average for the three elevations was found to be 0·063, 0·024, and 0·013 grms. of P_2O_5 per 100 c.c. of crusher juice. In fact, in the particular district under discussion, the tendency was so uniform that it would be possible with the help of a contour map roughly to predict the amount of phosphoric acid to be expected in the juice from any field. In certain of the fields, analyses of both the juice and soil were available, and the figures obtained collated in the order of decreasing P_2O_5 content of the juice were as follows :—

Field.	Elevation in ft	P_2O_5 in Juice.	P_2O_5 in Soil, extracted by 1 per cent. Citric Acid.	Cane Variety.	Tons Cane per acre.
15L......	25–150	0·048	0·0115	Str. Mex. D 1135	45·11
O1L......	25–50	0·048	0·0482	H 109	44·82
C8L......	100–300	0·034	0·0067	Str. Mex. H 109	37·59
14L......	25–200	0·033	0·0054	Str. Mex.	36·13
B3P......	300–500	0·032	0·0058	H 109	63·93
LB1L	100–350	0·026	0·0048	Str. Mex.	50·23
H8P .. .	200–300	0·024	0·0036	H 109	43·47
B9P......	400–900	0·020	0·0040	H 109	54·70
G4P......	400–500	0·014	0·0033	H 109	54·37
F6P......	700–900	0·013	0·0031	Str. Mex.	55·83
E5P......	800–900	0·013	0·0018	Str. Mex.	72·42
Standard..	—	0·020	0 0040	—	—

On studying these results, it will be seen that in a general way the P_2C_5 in the juice is proportional to that dissolved from the soil by a 1 per cent. solution of citric acid. Regarding the figures marked "standard," these are supposed to represent the dividing line for Hawaiian soils which responds and does not respond to phosphate fertilizer treatment, that of 0·020 per cent. for crusher juice being purely tentative, and subject to revision. There are some indications that even the poorest fields may have enough available P_2O_5 for their immediate requirements, seeing that Field E5P with only 0·013 per cent. produced the highest yield of cane of all tested, and moreover a very rich juice; but, on the other hand, there is the possibility remaining undetermined that it might have done even better with more phosphate. An objection which might be raised against trying to establish standards from such analyses is that the variety of cane may have as great an effect on the salts taken up as the soil itself; but no consistent difference in the effect in this respect of Lahaina, H 109, Striped Mexican, and D 1135 could be detected in these experiments. It is quite possible that cane juices will always contain a certain minimum amount of P_2O_5 and that its lack in the soil will be followed by lesser cane yields rather than by a further diminution of P_2O_5 in the juice. While we may never be able to conclude definitely from a juice analysis alone that a field needs phosphate fertilizer, a relatively high figure for P_2O_5 in the juice very probably will indicate that such fertilization is *not* needed, and thus by elimination help to locate field experiments where they are most necessary. An interesting correlation between field and factory work is worthy of note in this connexion. McAllep and Bomonti[1] found that the completeness with which a cane juice may be clarified depends very largely on the amount of phosphoric acid it contains, and placed the approximate limit below which clear, settled juices are not apt to be obtainable at 0·030 per cent. P_2O_5. According to this, those fields which consistently yield well-settled, brilliant, clarified juice may be dismissed at once as not in need of phosphoric acid, and more consideration may be given to fields whose juices clarify less readily.

[1] *Hawaiian Planters' Record*, **26**, 122.

ADSORPTION OF SUGAR FROM ITS AQUEOUS SOLUTION BY DECOLORIZING CARBON ("CARBORAFFIN"). Vlad. Skola. *Zeitsch. Zuckerind. cechoslov. Republik, 1923, 47,* (iv), *No. 16, 199-202.*

It is well known that on mixing decolorizing carbon with an aqueous solution of sugar, the concentration of the liquid diminishes as the result of adsorption; and this phenomenon has been the subject of a study by the author. A series of solutions of sugar, the concentrations of which were 7, 25, and 50 grms. per 100 c.c., were mixed for some time with different amounts of undried "Carboraffin," viz., 1, 2·5, 5, 10, and 20 per cent., and in a fourth series of solutions, 0·83, 8·3, and 16·5 per cent. of the *dried* decolorizing carbon were added, the density of all these liquids being determined at intervals by reading their refractive index. Graphs plotted from the results expressing diminution of concentration and time indicated that the course of the effect is rapid at first, but diminishes in its rate and reaches an equilibrium. In the case of solutions of 7, 25, and 50° Brix, when 20 per cent. of the carbon was added, this equilibrium is reached in 5, 10, and 30 min. respectively. Regarding the actual diminution of density, in the case of solutions having a concentration of about 25° Brix with additions of 1, 5, 10, and 20 grms. of the undried carbon per 100 c.c., this was observed to be 0·3, 1·2, 2·3 and 4·6° Brix. When carbon which had previously been dried was used, the lowering of the density (calculating on the actual dry substance content of the preparation) was smaller than when undried (containing 17·5 per cent. of water) was employed. This was due of course to the fact that the water present in the undried carbon served to dilute the solution to a certain degree; but even when making an allowance for this added water the effect was less, and it is suggested that the possibility of drying diminishing the adsorption is not precluded. An analysis of commercial "Carboraffin" gave the following results: Dry substance, 82·45; mineral matter soluble in HCl, 1·72; sulphated ash, 4·35; iron and aluminium oxides, 1·71; and zinc oxide, 0·69 per cent., in addition to which calcium oxide, sulphuric acid, and chlorine were also detected by qualitative tests.

ZINC CONTENT OF "CARBORAFFIN" DECOLORIZING CARBON. Vlad. Skola. *Zeitsch. Zuckerind. cechoslov. Republik, 1923, 47* (*v*), *No. 18, 257-258.*

"Carboraffin" decolorizing carbon, as is well known, is made from vegetable matter, such as sawdust, which has previously been treated with zinc chloride.[1] In a paper published about two years ago, it was mentioned that 0·82 per cent. of ZnO had been found in fresh "Carboraffin," 0·21 per cent. in the used, and 0·15 per cent. in the used and sweetened-off preparation. These amounts appear somewhat high; but after taking into consideration the fact that the amount of the decolorizing carbon used is only 0·1 per cent. of the raw sugar melted, and that only some of the zinc oxide present in the preparation actually enters the liquors, it may not be thought a matter of much importance. However, the manufacturers of the carbon in question have taken steps to reduce the zinc content of their production, and two samples recently examined by the writer showed an average ZnO content of only 0·024 per cent. (calculated on the dry matter), that is, only about 3 per cent. of that formerly present, a satisfactory reduction. Now the amount present in the carbon can certainly be regarded from the practical point of view as insignificant, since that capable of passing into the sugar from the use of such a preparation would, if capable of determination, be something in the fifth or sixth place of decimals.

DETERMINATION OF THE FINE GRAIN CONTENT OF MOLASSES. G. Schecker. *Vereinszeitschrift, 1922, 391-392.*

Recently a number of papers dealing with the quantitative determination of the fine grain content of cane and beet molasses has been published,[2] mostly using the refractometer; but the high results which have been obtained by such methods appear improbable. Though he does not indicate the source of error to which such methods may be subject,

[1] Zelniczek's French Patent, 471,295; *I.S.J.*, 1915, 197,488.
[2] *I.S.J.*, 1921, 327, 410, 413, 644, 647.

the author doubts their reliability, and attempts to obtain a true indication by the reverse procedure, namely, to start with a grain-free molasses, and to add to it increasing percentages of fine grain, thus constructing a scale, with which samples may be compared. He was then surprised to notice how high the fine grain content of a molasses containing only 0·5 per cent. appears to be; and as a fine grain content of 0·5 increases the purity by only 0·24° and the Brix content by only 0·08 per cent., he concludes that methods based on the use of the refractometer and polarimeter are unsuitable for the purpose in view, and that results much closer to the truth are obtainable by means of his so-called "molasses fine grain scale."

REPORT OF THE NEW YORK SUGAR TRADE LABORATORY FOR THE YEAR ENDING DECEMBER 31ST, 1922. *C. A. Browne. New York Sugar Trade Laboratory, Inc., 80, South Street, New York, U.S.A.*

Dr. BROWNE reports that during 1922 the number of samples tested in the Laboratory was 22,165 (as compared with 15,147 for the previous year), corresponding to a total number of bags of 36,503,760. Owing to the comparatively even distribution of the deteriorated stored sugars of the 1921 crop, and of the new sugars of the 1922 crop over all the months of the year, the average monthly polarizations in 1922 showed less variation than for any previous year in the history of the Laboratory, the difference between the maximum and minimum monthly averages being only 0 78°. The sugars between 90 and 95 polarization, consisting largely of deteriorated centrifugal sugars, made up the unprecedented high figure of 24·20 per cent. of the total receipts in 1922; the corresponding figure for 1921 was 20·55 per cent., the average of the previous ten years being 15·26 per cent. These comparisons show to what extent the stored sugars of the past two campaigns underwent deterioration. Notwithstanding the large amount of deteriorated sugar received in 1922, the average polarization of 95·48 for the year is above the average value, 95·35, for the previous ten years. This was owing to the fact that the low grade molasses and mat sugars below 90 polarization, which for the previous ten years made up an average of 4·11 per cent. of the year's total receipts, amounted to only 0·52 per cent. in 1922.

FORMULA FOR THE FUEL VALUE OF BAGASSE. *Ph. Van Harreveld. Archief, 1922, 30 No. 27, 477-478.*

According to the formula stated by the Java Experiment Station for the calculation of the fuel value of bagasse for the purpose of factory control, the number of calories in 1 kg. of the material is: 4600 — 8 polarization — 53 water. Different correspondents have written to Dr. HARREVELD stating that it was not clear why eight times the polarization should be abstracted at the same time as fifty-three times the water. Replying to this enquiry, the Director of the Experiment Station explains that in the value 4600 the polarization is already included on the basis that sugar has the same fuel value as fibre. Actually, however, sugar yields 3950 calories, while fibre gives 4740, so that allowance must be made for the difference. This formula is nothing more than a simplified algebraic development of the original one, as appears from the following: the calorific value of ashless fibre is 4740, and of sugar 3950, while the heat of evaporation of water corresponds to 540 calories, so that the number of 1 kg. of bagasse is 4740 × weight of ashless fibre 3950 + weight of sugar — 540 × weight of water. Substituting these weights by the corresponding contents, and dividing by a hundred, one obtains 47·4 (100 — 3 — polarization — water content) + 39·5 × polarization — 5·4 × water content = 47·4 × 97 — (47·4 — 39·5) × polarization — (47·4 + 5·4) × water content = 4597·8 — 7·9 — 52·8 water, and this in round figures = 4600 — 8 polarization — 53 water. It has already been explained[1] how the simplified formula is derived from the old one: 4740 × fibre + 3950 × sugar — 540 × water; or from the formula given in GEERLIGS' book[2]: 4750 × fibre + 3955 × sugar + 3750 × reducing sugars — 540 × water But the simplified formula: 4600 — 8 polarization — 53 water is sufficient for the purpose of fuel control in the sugar factory.

J. P. O.

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[1] *Jaarverslagen der Techn. Afd.*, 1916, 59; 1917, 48.

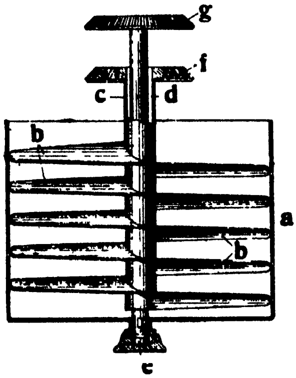
[2] "De Fabricatie van Suiker uit Suikerriet op Java." By H. C. PRINSEN GEERLIGS. Third Dutch edition. Page 132.

Review of Recent Patents.[1]

FRANCE.

CONTINUOUS CENTRIFUGAL MACHINE FOR MASSECUITE. *Olivier de Villele. 544,958.* April 28th, 1921. (One figure.)

This invention concerns a continuous centrifugal for the separation of sugar crystals from massecuite, characterized by the provision concentrically to the spindle of the machine of a hollow spindle carrying an Archimedean screw of small pitch and of a slightly smaller diameter than that of the perforated basket. This Archimedean screw is revolved at a speed and in a direction such that the helix collecting the crystals which are projected on the walls of the basket causes these crystals gradually to rise to the top of the machine. An example of the invention is shown in the drawing reproduced herewith. In the interior of the perforated basket *a*, provided with a metallic cloth lining, is mounted an Archimedean screw *b* in one piece with a hollow spindle *c*, concentrically with the spindle *d* of the machine, supported by the bearing *e*. This Archimedean screw *b* has a small pitch, and is rotated by means of a conical pinion *f* supported on its spindle *c*; while the basket *a* of the machine is revolved by the pinion *g* supported on its spindle *d*. The speed and direction of the Archimedean screw are such that the helix collecting the crystals projected on the walls of the baskets cause these crystals to rise gradually along the wall of the basket *a* and then over it; while the syrup is thrown through the perforations of the basket. On arrival at the top of the basket, the crystals are collected in any suitable manner.



UNITED KINGDOM.

ROTARY PUMP. *John A. Mair and Archibald C. Cairns,* both of Greenock, Scotland. *186,271.* November 23rd, 1921. (Five figures; four claims.)

Claim is made for a rotary pump of the type having a drum-shaped rotor with radial slots or recesses in which sliding vanes carry rollers at their outer ends. These rollers press against the interior surface of a cylindrical casing within which the rotor rotates, the said casing being produced with an admission and a discharge port, and the fluid being carried from the former to the latter in the "active" portion of the pump in compartments enclosed by the exterior surface of the rotor, the interior surface of the casing, and two of the said rollers. The claim is characterized by the fact that three or more rollers are employed, that at least one roller is always in the "idle" portion of the pump between the discharge port and the admission port, and that neither the rotor nor any of the carriers makes contact with the interior circumferential surface of the casing, or with any abutment projecting inwardly therefrom.

CENTRIFUGAL MACHINE FOR THE SEPARATION OF SOLID PARTICLES FROM FLUIDS. *F. L. Smidth & Co.,* of Copenhagen, Denmark. *186,631.* October 2nd, 1922.

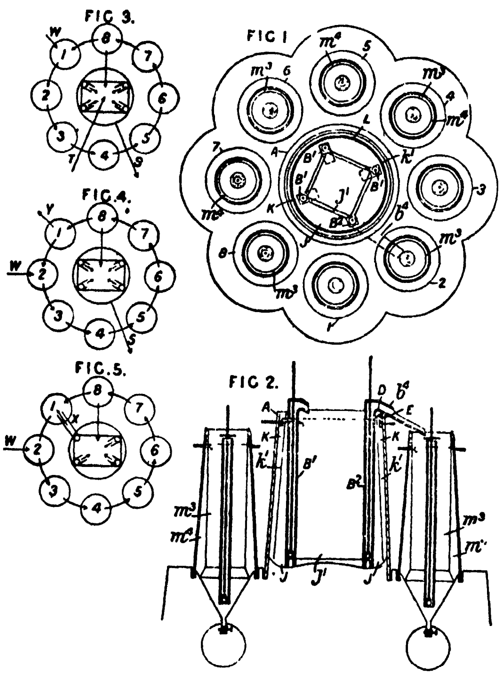
The apparatus is of that type in which the fluid to be treated is caused to flow through a chamber wherein fins, blades, or the like, rotate about an axis parallel to the direction of flow, so that the fluid and solid particles suspended therein are subjected to centrifugal action in order that the solid particles may be thrown away from the axis of the chamber. Its distinguishing feature resides in the provision of suitably placed bodies

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

or members which are placed in the space between the outer edges of the fins and the casing of the apparatus, so as to offer a certain resistance to the movement of the fluid in the direction of the axis of the chamber, thereby screening the particles thrown out into said space from the action of the flow of fluid, and thus enabling them to be discharged readily by suitable means.

Extraction of Sugar from the Beet (and the Production of other Extracts). *W. A. Fraymouth, J. A. Reavell, and Kestner Evaporator & Engineering Co., Ltd.*, of Grosvenor Gardens, London. *177,820.* October 5th, 1920.

Extracts are prepared from beets, crushed or powdered substances (other than tan-stuffs), etc., by a process whereby the powdered substances are first treated in a wetting zone *JJ* of a gas-lift agitator *A* with a liquid already rich in soluble matter; three-quarters of the mixture is then returned to the wetting zone *JJ* by the pipes B^1, but that portion which passes up the pipe B^2 divides at perforations *D* in the under side of a bend b^4 at the top of pipe B^2, the liquid falling through the perforations and being deflected by a plate *E* into an annular zone *J* in the agitator *A* between two canvas or other impervious partitions j^1, k^1, and a mixture of liquid and wet substances passes over into the agitation zone m^3 of any selected one of a ring of smaller gas-lift agitators *1 . . 8*, Fig. 1. The solution in the first annular zone *J* in the main agitator *A* rises slowly in a second annular zone *K* and thus becomes clarified, finally passing off over a knife-edge *L* into a discharge pipe leading to an evaporator, etc. The solution from the agitating zone m^3 of the smaller agitators passes upwards through a zone m^4 separated from the other by an impervious canvas or other screen and passes over a knife-edge to a pipe communicating with the agitation zone of the next agitator. The successive phases of operation in an apparatus containing eight subsidiary and one central agitator are described in the specification and illustrated by means of diagrams.



Specific Gravity Determination using a Hydrometer. *C. Russell*, of Edgbaston, Birmingham. *187,484.* November 22nd, 1921.

An apparatus is described in which the hydrometer (when immersed in the liquid under examination contained in a cylinder) is provided with micrometer devices for measuring the extent to which its stem projects above the surface of the liquid.

Alcohol Motor Fuel, containing Ether. *Benj. H. Morgan.* *189,715.* April 22nd, 1922.

A fuel for internal combustion engines comprises a mixture of alcohol and ether to which is added castor oil, preferably in proportions of 0·2 to 5 per cent.

EXTRACTION OF THE SUGAR FROM THE BEET, AND THE CLARIFICATION OF THE RESULTING JUICE. *Plauson's (Patent Co.) Ltd.*, of Pall Mall, London (communicated by *Hermann Plauson*, of Hamburg, Germany). *190,314*. October 28th, 1921. (No drawings; five claims.)

A new process has been discovered which is claimed to represent a very substantial simplification in the manufacture of sugar from the beet. Syrup can be made in such a simple manner that the operation is remunerative on a small scale, although obviously manufacture on the large scale is still cheaper. According to the invention, the beets are treated in a special type of filter-press after special preliminary treatment. The procedure departs radically from that used for beet extraction and also from normal practice in filtration. Usually it is desired to obtain the particles in a form in which they will filter most readily; and to this end the obvious procedure is to avoid rupture of the cells in such manner that a colloidal solution would be obtained, since such a solution would be difficult to filter. But in the inventor's process, the beets are so treated as deliberately to cause the finest disintegration of the cells with the consequent advantage that a thorough extraction of sugar can be rapidly effected, since it is no longer necessary for the sugar to diffuse through the minute cell walls; the disintegrated mass is then treated at high pressure in an ultra-filter press such as described in United Kingdom Specification No. 155,834 or in Specification No. 181,023,[1] which is capable of removing colloidal matter from the liquor. The pores of the filter element may be reduced in size by causing cement to set therein, and the cement (or the like) may be impregnated with a colloid such as rubber, by treatment with a rubber solution and subsequent drying. Disintegration may be effected by treatment in the colloid mill as described in U.K. Specification No. 155,836, or by combined heat or pressure. The invention further includes a process for the manufacture of pure sugar syrup consisting in treating comminuted beets as above described, adding lime, and then saturating with carbon dioxide in known manner before treatment in the ultra-filter press under high pressure. The invention further includes a process for purifying sugar liquors in which they are treated with absorbent material, such as decolorizing carbon or the like, either after treatment in a colloid mill with the addition of lime and subsequent saturation or not, in either case prior to filtration under high pressure in an ultra-filter press.

Example 1:—Beets are freed from dirt by washing and comminuted in known manner by cutting or preferably squeezing to a pulp between pressure rollers; 100 parts of the comminuted material or paste are diluted with cold or warm water in a colloid mill (or like rapidly rotating disintegrator) for 1 to 2 minutes; the paste is thus so thoroughly divided that all the cells are ruptured, and the sugar is completely extracted. Milk-of-lime is now added (0·3 to 1 per cent.) and the treatment is continued for 0·5 to 1 min. longer. Owing to the fine state of division the chemical action of the lime is then complete and treatment by saturation with carbon dioxide can be effected in the mill, so that the whole process is over in a few minutes. The product is then filtered under high pressure by an ultra-filter press. It has been found that the ultra-filter press will continually and automatically deliver a completely clear syrup which only contains small quantities of soluble proteins and the like contained in the beet, and on the other hand a beet residue poor in water in which only small quantities of sugar remain behind. If it is desired to recover this residual amount, the pressed cake in the filter is treated with a further quantity of water, and subjected to further ultra-filtration in the same press. As in good working in diffusion batteries, a press cake may thus be obtained whose sugar content does not exceed 0·3 to 0·5 per cent. The sugar juice is usually so pure that it can be concentrated direct to syrup or cause to crystallize in the usual manner. To obtain a refined product, the sugar liquor can be subjected to a further treatment with lime and carbon dioxide, with or without the use of decolorizing carbon, and again separated from the impurities by filtration.

Example 2:—In the manufacture of sugar on the large scale, 100 parts of finely divided beet are heated by direct admission of steam or by passage through a steam-heated

[1] *I.S.J.*, 1921, 594, 680.

pipe to 60 to 85°C., and subjected under a pressure of 10 to 100 atmospheres to filtration in an ultra-filter press. In this case pressure, extraction, and filtration are performed continuously in a single operation. The extraction is complete, owing to the heating and subsequent action of water under high pressure, and filtration simultaneously occurs. Experiment has shown that the proteins and pectins are retained in the press residue in considerably greater amount than in the diffusion process. The desaccharified pressed cakes are continuously removed from the press and can be subjected to further treatment as in Example 1. The crude juice so obtained is now treated in the colloid mill by the addition of lime, and then saturated with carbon dioxide and sulphur dioxide, and if desired decolorizing carbon or the like adsorbent may be added, and the juice finally purified by filtration, a completely pure juice then resulting.

Example 3 :—Treatment of the crude juice can be still further simplified, since it has been found that an addition of 0·5 to 2 per cent. of decolorizing carbon, fuller's earth, or the like material, effects a sufficient refining, if followed by treatment in an ultra-filter press, it thus being possible to dispense with treatment with lime and saturation, It was not known that sugar juice could be obtained by the employment of the colloid mill, and in particular of the ultra-filter press, in the above described simple manner, especially since filtration of sugar solutions has hitherto been a tedious and difficult operation. Also it would not have been foreseen that the ultra-filter press could be used to perform extraction, pressing, and filtration of the sugar solution in a single operation.

GERMANY.

PRODUCTION OF A WHITE MASSECUITE IN THE GERMAN BEET REFINERY. *Adolf Hinze,* of Gr. Salze, Germany. *353,194.* April 1st, 1921.

It is said by the patentee that the usual procedure in refining of washing in centrifugals (affining), remelting, purifying by means of bone char, and boiling to grain has "considerable disadvantages," demanding time, consuming heat, and producing colour. His method is to wash the raw sugar in centrifugals; to grind the greater part (50–70 per cent.) of the white crystals obtained to a fine meal; to re-melt the smaller part to a liquor which at 60-80°C. is saturated; to mix together the fine meal and the saturated liquor; and lastly to draw this "massecuite" into a vacuum pan, and there boil it to the necessary concentration and at the desired temperature.

PRODUCTION OF DECOLORIZING CARBON. *Badische Anilin und Soda Fabrik,* of Ludwigshafen a. Rhein, Germany. *338,852.* September 21st, 1919.

Carbonaceous substances are heated with a volatile metallic chloride, especially that of aluminium and ammonium, but excluding that of zinc.

SEPARATION FROM BEET JUICE OF THE PRECIPITATE RESULTING ON TREATMENT WITH SULPHUROUS ACID. *"Reinzucker" Gesellschaft für Patentverwertung m. b. H.,* of Berlin. *358,686; 358,687; 358,688; 358,771; 358,772; 360,152; 360,686; 359,710; 359,711.* March 7th, 1918; April 12th, 1917; June 16th, 1917; April 12th, 1917; March 2nd, 1918; September 7th, 1918; October 7th, 1917; April 12th, 1917; January 15th, 1920.

These patents relate to processes for the separation of the precipitate resulting on sulphiting raw beet juice, the substances thrown out of solution (which consist of proteins, pectins, and fats,) being believed to have a certain commercial value. In the first patent, claim is made for the method involving the use of water which has been artificially hardened by treatment with lime and subsequently saturated with carbon dioxide, as lixiviating liquor in the diffusion process, a juice which is nearly free from albumins being thus yielded. In the second specification the procedure described is to sulphite the raw juice coming from the battery (at a temperature anywhere between 60 and 80°C.) until a voluminous, flocculent precipitate forms, then to lime it to an alkalinity of 0·04–0·08, after which it is sent through the heaters and filter-presses. Juice thus treated is said to filter readily.

UNITED STATES.

Discharging Plough for Centrifugal Machines. *E. D. Mackintosh* (assignor to *S. S. Hepworth Co.*, of New York). *1,431,016.* October 3rd, 1922. (Two figures; six claims.)

A plough is provided for use in a centrifugal machine discharger, which permits the basket to sway somewhat, and still maintains contact with the lining without causing excessive wear due to intensity of pressure. It comprises a rear portion *A* attached to the shaft *E*, and prevented from rotating thereon by the feather *D*, as illustrated in a previous specification,[1] together with a tip *E* pivoted at *F* on the rear portion *A*, and provided with a scraper *G*, attached to its forward end, and a tail *H*. A spring *K* normally holds the tip in an extended position bearing against the centrifugal liming *M*. In the operation of an unloader provided with this plough when the plough is advanced into the sugar, its rear portion *A* is held by means of the shaft *C*, in a fixed relation to the centre of the centrifugal basket. As this basket sways or as any inequalities in the lining approach the unloader, the tip *E*, pivoted about *F*, moves to and fro slightly, thus preventing injury to the screen *M*, and at all times maintaining contact with the same and preventing the plough jumping over some of the material. Should the spring *K* break, or for other reason fail to function, the tip *E* is positively moved into extended position to engage the material in the basket by reason of the engagement of the tail *H* with the latter. Once the tip *E* has been forced into the material, the pressure of the latter thereon maintains the tip in operative position against the wall of the basket.

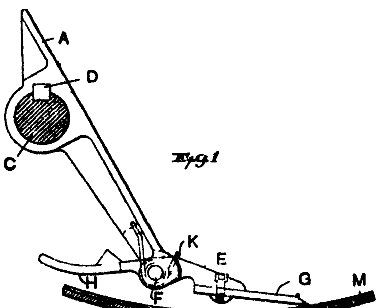


Fig. 1

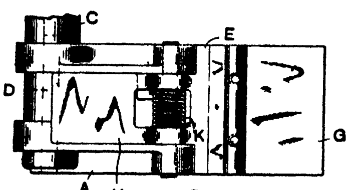


Fig. 2

Continuous Production of Ether. *Emile A. Barbet* (assignor to *E. Barbet & Fils & Cie.*, of Paris, France). *1,436,332.* November 21st, 1922. (Two figures; two claims.)

Alcohol passes into a tubular heater where it is converted into vapour, which is led by a pipe into the bottom of a device containing dividing materials such as porcelain balls, lead plates perforated with small holes, or a charge of broken quartz, in which device the alcohol and sulphuric acid are brought together. The bottom of the device communicates by a pipe with the lower part of a boiler containing acid at a high temperature. The acid from which the ether has been distilled flows from the lower part of the boiler into the lower part of the device. Acid and the alcohol are thus brought into intimate contact in the device, while the ethyl sulphuric acid formed enters into the upper part of the boiler which contains a leaden heating coil in which steam under pressure circulates. The ethyl sulphuric acid which has already a high temperature on its entry into the boiler is thereby further heated; decomposition of the ethyl sulphuric acid takes place and the ether vapour rises and it is withdrawn for rectification. When the ethyl sulphuric acid reaches the bottom of the boiler it contains necessarily a predominance of sulphuric acid and is therefore used for again combining with alcohol in the device already mentioned.

Decolorizing Carbon, and Decolorizing Phosphoric Clarifier.[2] *Claude S. Hudson*, of Hyattsville, Maryville, U.S.A. *1,438,113.* December 5th, 1922. (No drawings; 17 claims.)

[1] U.S. Patent, 1,326,411; *I.S.J.*, 1920, 233. [2] See U.K. Patent, 139,156; *I.S.J.*, 1920, 356.

MANUFACTURE OF CARBONACEOUS CHAR (DECOLORIZING CARBON). *Hugh Rodman*, of Oakmont, Pa. (assignor to *Rodman Chemical Co.*, of Pennsylvania, U.S.A.). *1,433,039*. October 24th, 1922.

Claim 1:—The method of producing powdered carbonaceous chars which consists in reducing coking coal to a powder, gradually heating a mass of the powder to a coking temperature by applying a slow external heat to the receptacle in which the mass is located while the mass is exposed to the air, and in agitating the mass during at least a portion of the heating operation, thereby maintaining the mass in powdered form throughout the coking operation.

PROCESS OF EVAPORATION. *Oliver E. Merrell*, assignor to *The Merrell-Soule Co.*, of Syracuse, N.Y. *1,443,714*. (Six claims.)

Claim 6.—The process of concentrating a substance-containing liquid consisting in introducing the liquid into one end of a vertically arranged container having an annular portion with concentric annular treating surfaces, heating the interior and exterior surfaces of the annular body of liquid confined between said annular treating surfaces to a temperature sufficient to vapourize liquid constituents of the material treated at the pressure maintained in the container, mechanically moving the substance relatively to said treating surface and in a rotary direction within said container, separating the vapour from the liquid at the upper end of the body of liquid, and condensing the vapour to produce high vacuum in the container.

PRODUCTION OF FATTY ACIDS BY THE FERMENTATION OF CELLULOSE. *Herbert Langwell*, of Stockton-on-Tees. *1,443,881*. January 30th, 1923. (Five claims.)

Claim 5.—Process for the production of fatty acids of a boiling point up to 168°C. from cellulose, which comprises fermenting cellulose at a temperature not exceeding 70°C. by introducing aerated tap-water, sulphite pulp half-stuff, precipitated chalk, glucose, and nutrient substances composed of ammonium chloride, sodium chloride, potassium phosphate, and material from the centre of a steaming stable manure heap, stirring the mixture, and allowing it to stand for 12–24 hours, thereupon continuing said stirring and introducing air during 1–2 hours, repeating the operations until fermentation ceases, and recovering the calcium salt of the fatty acid formed from the mixture.

FILTER-PLATE. *John J. Naugle*, OF BROOKLYN, N.Y., U.S.A. *1,441,446*. January 9th, 1923. (Seventeen claims).

Claim 1.—A filter-plate having a depressed filter surface framed by a plain raised surface, the filter surface and the plain surface being joined by an inclined surface, studs rising from the filter surface, and studs rising from the inclined surface, and having their top surfaces inclined in a plane extending from the top of the studs on the filter to the raised surface.

BEET TOPPERS. (1) *Frank Pocock*, of Salt Lake City, Utah, U.S.A. *1,439,187*. December 19th, 1922. (2) *Aloa M. Ricks*, of Los Angeles, Cal., U.S.A. *1,445,449*. February 13th, 1923. (Twelve claims) (3) *Marion A. Smith*, of Salt Lake City, Utah, U.S.A. *1,439,026*. December 19th, 1922. BEET CULTIVATORS. *Nello Ciarl*, of Weldona, Col., U.S.A. *1,442,251*. January 16th, 1922. (Three claims) BEET HARVESTERS. (1) *T. E. Moore*, of Grand Junction, Colo., U.S.A. *1,442,963*. January 23rd, 1923. (Four claims.) (2) *Ronald Moreschini*, of Pueblo, Colo., U.S.A. *1,445,535*. February 13th, 1923. (Three claims) BEET LOADERS. *Victor Castillo*, of Fort Morgan, Colo., U.S.A. *1,444,829*. February 13th, 1923. (Six claims.)

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922 Tons.
Total Receipts, January 1st to March 28th	968,396	..	1,104,989
Deliveries ,, ,, ...	957,557	..	1,080,695
Meltings by Refiners ,, ,, ...	770,160	..	904,292
Exports of Refined ,, ,, ...	30,000	..	132,000
Importers' Stocks, March 28th	10,839	..	24,294
Total Stocks, March 28th..	209,355	..	222,431
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1920-21 Tons.		1921 22 Tons		1922 23 Tons.
Exports	337,563	..	253,940	..	886,195
Stocks	499,519	..	414,512	..	460,009
	837,082		668,452		1,346,204
Local Consumption	20,000	..	20,000	..	17,000
Receipts at Port to February 28th	857,082		688,452		1,363,204

Havana, February 28th, 1923. J. GUMA.—L. MEJER.

Sugar Crops of the World.

(Willett & Gray's Estimates to March, 1923.)

	1922 23. Tons.		1921-22. Tons.		1920-21. Tons.
CANE.					
America	6,744,575	....	6,892,093	....	6,618,590
Asia	5,015,800	....	4,894,736	....	4,613,094
Australasia	352,000	....	363,701	....	255,401
Africa	541,260	....	519,227	....	588,469
Europe.................	6,000	....	5,000	....	6,886
Total Cane..........	12,659,635		12,674,757		12,082,440
BEET.					
Europe.................	4,662,690	....	4,049,821	....	3,681,461
U.S.A..................	625,000	....	911,190	....	969,419
Canada.................	15,000	....	18,931	....	34,600
Total Beet	5,302,690		4,979,942		4,685,480
TOTAL CANE AND BEET..	17,962,325		17,654,699		16,767,920

THE

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Budget and Sugar.

On April 16th last Mr. STANLEY BALDWIN, Chancellor of the Exchequer, introduced his first Budget to an expectant House of Commons which was cheered by the announcement of a number of taxation reductions. A decrease in income tax was expected as a matter of course and the 6d. taken off though no great sum was welcomed by all parties except Labour. The much criticised Corporation Tax, which is in effect a tax on Ordinary shareholders of limited companies, is to be halved this year and will probably disappear in 1924.

Of the indirect taxes, both beer and sugar had been marked out by the prophets for alleviation; we remarked a year ago, that beer would have the first claim this year, as there was a strong public feeling that the national drink should now bear less taxation than that imposed on it under war conditions. So it was with no surprise that the House heard that 20 per cent. reduction was to be conceded, equal to 1d. per pint. As for sugar the prophets seemed unanimous in the belief that 1d. per lb. would also come off this, thereby reducing the tax from 2¾d. to 1¾d. per lb. But Mr. BALDWIN was advised that in the present position of supply and demand in the sugar industry, the comparative shortage of sugar would militate against the consumer reaping any benefit from a reduction in the duty. Any allowance made would in all probability be pocketed by the suppliers in America or elsewhere. Mr. BALDWIN argued that a reduction in duty would of course result at the start in a corresponding reduction in price but this might lead to an increased demand that would further accentuate the sugar shortage and so increase the world's price further. He anticipated the argument that even if prices did rise they would still be lower by the extent of the reduction in duties, but his reply was that any increased demand would result in a greater increase in prices than would otherwise take place. So he was reluctantly compelled this year to refrain from lowering the sugar duty.

On the whole, the soundness of this reasoning seems to be conceded by those having to do with the sugar market, though the opinion is expressed that increased consumption would not necessarily follow a reduction in duty, the consumption being dependent on a number of factors of which price is only one. If we turn Mr. Baldwin's argument into concrete figures and assume that a reduction of 1d. per lb. increases the consumption in this country by 30,000 tons per month or say

350,000 tons per annum, the world's price of sugar would have to rise by at least £10 per ton to attain the "greater increase" above referred to. Would it? It seems quite possible, for the augmented consumption of 350,000 tons would greatly increase the deficit which it is thought will be recorded in the visible supplies next August and which Messrs. LAMBORN & COMPANY have already estimated at some 200,000 tons. A shortage of over 500,000 tons would be bound to send prices up by more than £10 per ton. It is true that the estimates of the 1923 beet sowings as published by F. O. LICHT show an increase over last year of 18 per cent., or some 800,000 tons more of sugar. But this will not beavailable much before the end of the year. So if between now and Christmas the consumption increased as a result of lowering the duty, we think it is more than likely that the price would for a while be raised by the producers and dealers by more than 10s. per cwt.

Whether the sugar consumption would be increased greatly or at all by a reduction of 1d. per lb. from its present retail price of 8d. for cubes and 7d. for granulated, is more a matter of speculation. As we said above, the price is only one factor governing the consumption; other factors are public taste and especially public ability to purchase. As to the last, it may be said the gradual increase recently experienced in employment in this country if maintained will correspondingly increase the public ability to buy sugar, other things equal, since men earning steady wages (as compared with doles) will be better able to provide the funds for a full family budget. However, the Board of Trade Returns for March[1] give the consumption of sugar in the United Kingdom for the first three months of the year as 322,142 tons, as compared with 350,423 tons in 1922 and 334,362 tons in 1921. Compared with last year this is an average decrease of 9427 tons monthly and shows that the purchasing power of the nation in respect to this article of food has not increased over last year, though the upward tendency of the price since January must have had some effect in restricting sales.

The decision to maintain the present high duty on sugar for another year can be viewed by us from several aspects. In so far as it prevents increase in consumption it will affect the producers throughout the world; but these still probably prefer a steady demand for sugar at good prices than a repetition of the market conditions of 1920 and 1921 when the industry was demoralized by a meteoric rise and fall in prices and received a setback from which it is only now slowly recovering; moreover when prices are sent skyrocketing, it is generally the middleman and the speculator who pocket the increment, not the producer who has frequently sold his crop in advance. It will therefore be no disadvantage if for this year at least there is no inducement to increase sugar consumption in any of the big consuming areas.

For Imperially produced sugar the *status quo ante* is an advantage since it maintains unimpaired for another year the preference of one-sixth off the duty on such sugars entering Great Britain. Had the duty been decreased by 1d. the intrinsic value of the preference would have been reduced by five-sixths of 1d. per lb. or 27s. per ton for 96° sugars (£2 8s. instead of £3 15s.). The Empire producers were strongly averse to any such reduction and, as we pointed out in our February issue, were intent to have the preference fixed at a minimum of £3 15s. irrespective of the amount of the duty. The passing over of sugar in the present Budget reductions maintains this advantage to them, without the Government having to re-arrange the form of the preference in any way—a task they will not be sorry to be able to postpone until after the Imperial Economic Conference has met in the Autumn.

[1] These figures should have appeared in our last issue, but owing to a strike in the Government Stationery departments they were issued too late during April. See page 279.

As for the consumer in this country, he is undoubtedly faced with some months of high prices for sugar, owing to the supply not being oqual to the world's demand, so he would gain precious little, if any, benefit by a reduction in the duty for the time being. As soon as production has once more overtaken consumption, he will have a strong claim for consideration at the hands of the Exchequer, since the present duty is indefensible as an item of normal taxation.

The Moral of It All.

It is to be hoped that the real reasons for the inability of the Chancellor of the Exchequer to grant the sugar consumer relief from the burden of high prices will not be lost on our legislators at Westminster. Not merely do we in this country depend for practically all our sugar on overseas agriculture, but the vast bulk of it is not even produced within the Empire but in foreign countries where there is no sentiment in business and the seller's only idea is to get the best price he can for his output. Before the war, the British consumer depended on Germany and Austria-Hungary for the bulk of his sugar, and whenever these sources, by means of their bounties and Cartels, managed to get the upper hand in the world's market, we had to pay for it. Hence the long drawn-out efforts to get the bounties abolished and the Cartels restricted. Now after the Great War (which supplied in itself a striking illustration of the inconvenience, not to say risks, of the United Kingdom impoiting so much of its agricultural produce) we seem in danger of merely exchanging a subservience to European beet sugar for one to Cuban cane sugar and behind that to American cane growing and sugar refining interests controlled in the United States. The effect of this is being seen now in the excessive price the British consumer is being asked to pay for his sugar—a price which may be increased 40 per cent. further before this summer is out. The remedy is to broaden the basis of supply: to encourage beet sugar production at home and to develop cane sugar production within the Empire where, other things equal, we are less likely to have a stiff bargain forced on us in years of comparative scarcity.

It is admitted even by the *West India Committee Circular* that we cannot expect any radical increase in the output of sugar from our West Indian Crown colonies; there is not available in them a vast tract of virgin soil suitable for cane cultivation such as awaited the capitalists who have exploited Cuba so successfully. But there are other regions of our tropical Empire where development is possible, and it only wants steady support on the part of the Government at home to justify Capital in embarking on such enterprises as will greatly increase the Imperial contribution to the two million tons of sugar that this country should be capable of consuming if the price were reasonable and employment were normal. An Imperial Economic Conference is due to meet in England in the coming autumn, and with the concrete results before them of the present shortage of sugar, it is to be hoped that both the British home politicians and the Overseas representatives will discuss the problem with a determination to find a solution that can be put into effective operation and not merely begin and end with pious resolutions such as have figured frequently in the past but have produced no tangible results.

Scope for Improvement in the West Indies.

Granted that there is no chance of the British West Indies and British Guiana multiplying their cane areas on a Cuban scale, there is scope nevertheless for an appreciable augmentation in the output of sugar cane and of cane sugar. These colonies have been in the past too much the sport of the fluctuations of

fortune in the sugar industry; and in Jamaica agriculture has changed from sugar to bananas and then back to sugar to a degree that has hindered all progressive expansion of the sugar industry in our principal West Indian island. Drought in the islands and floods on the mainland have had their adverse effect, so that the full benefits of a year of good prices have frequently been lost to the colonists. Contrariwise, bumper crops have now and then been produced only to be sold at unremunerative prices. The West Indian sugar industry suffers from at least two main drawbacks. In the first place it has not sufficient financial reserves to tide it over bad seasons to the extent that other sugar regions have; nor does it seem able to finance communal schemes such as public irrigation so as to be more independent of drought. Secondly, its sugar factories are in the main a multiplication of small affairs instead of being a fewer number of well equipped centrals, and where rum has hitherto been a large consideration, the extraction of sugar has been maintained on an inefficient scale. Neither circumstance assists in the economic production of sugar, and it is inevitable that as compared with other sugar industries the profits must be less and the consequences of a bad season be more quickly felt. On another page we give a brief review of conditions in the West Indies from the point of view chiefly of the sugar factory engineer. Amongst the outstanding features that call for remedy if the industry is to be put on a modern footing are the inefficient boiling stations still prevalent in those factories intended to produce sugar and rum. Unless prohibition is dropped in America, rum in quantity is a "back number," and the factories that made such a profit out of this by-product at the expense of their sugar extraction will be bound now to modernize their boiling plants and increase greatly their sucrose extraction. There is a good deal of scope then for British evaporator manufacturers to renovate these West Indian factories. Then in some places, particularly in Barbados, individual effort is so marked that toy crushing and evaporating plants are almost the rule; a much smaller number of large central factories would spell greater economy, and if the planters could only be induced to combine and supply the raw material to such centrals, they would be in a much stronger position to stand the extreme fluctuations of the sugar market. Tiny sugar factories, however well fitted on a small scale, are no longer economic propositions in the sugar world, and if Imperial Preference is to be a permanent feature, we have little doubt that it will be on conditions postulating a higher standard of efficiency than the average West Indian factory possesses. There are not wanting exceptions to this state of affairs even in those islands, as our review elsewhere testifies, but such factories as Grays Inn are the exception indeed; they are, however, an example of what can be done where sufficient enterprise is shown, and should be a stimulus to other sugar factory owners to go and do likewise.

The Effect of the Budget Announcement on the New York Market.

It is interesting to note the effect that Mr. Baldwin's Budget announcement on the sugar duties had on transactions on the New York market which he had indicated as having the control for the time being of sugar prices. Prior to the Budget, this market was steady[1] with Cubas selling at 5¾ c., C. & F., but on the publication of Mr. Baldwin's remarks a large foreign buying interest set in. Correspondents in New York of foreign buying houses immediately entered the market and commenced buying all Cuban sugar that they could obtain on the basis of 6 c. C. & F., at first limiting their purchasing to May shipment, but afterwards

[1] We quote Messrs. Willett & Gray's Sugar Trade Journal.

extending their buying to any shipments. Naturally when the American refiners became aware of these conditions, they also entered the market and purchased all the sugars they could obtain on the 6 c., C. & F. basis, estimated at 200,000 bags, and then advanced their limits to 6⅛ c., C. & F., at which price only a few sugars were obtained, and later on to 6¼ c., C. & F., at which quotation some 50,000 tons of sugar were sold to the various refiners, including Cubas, at 6¼ c., C. & F., and Philippines and Porto Ricos at their duty paid equivalent of 8·03 c. In addition to European buying, Canadian refiners also became interested and purchased Cubas on f.o.b. Cuba values of 5·95 c., 6 c. and 6·10 c., and San Domingoes at 6 c. and 6¼ c., c.i.f. Canadian Atlantic ports.

A New Era for Indian Sugar Cane Cultivation.

Elsewhere we reproduce the annual report of the Agricultural Adviser to the Government of India (Mr. S. MILLIGAN) in so far as it deals with sugar cane experimental work in India. The principal achievement is undoubtedly that which is summed up in a sentence in the preface to the whole report: "Prominent amongst the new features of this year's operations are . . . the successful trials on a field scale of the seedling sugar canes bred at the All-India Sugar Cane Station at Coimbatore in Madras—a successful outcome of the distinguished work, performed under great difficulties in the closing years of his service, by Dr. C. A. BARBER, late Imperial Sugar Cane Expert, ably assisted by his staff." We have in fact seemingly reached a new era in the cultivation of sugar cane in India; there seems a strong probability now that, thanks to the pioneer work above referred to and suitably acknowledged, the production of sugar in what is really the largest cane growing country in the world will cease in an increasing degree to depend for its raw material on a type of cane which, while it has in the past had peculiar merits for Indian cultivation, has equally possessed defects—difficulty in milling and in manufacture, and in the north very poor tonnage—that have rejected it in the eyes of all other sugar cane growers of the world except Natal. The problem even in India has of recent years been the need of cane that would stand the extremes of climate well, and yet would yield a much bigger output whether for gur or for white sugar manufacture. It seems to be virtually solved by the evolution of the Coimbatore seedlings, one of which (CO 205) is already giving 60 to 80 per cent. higher yield of gur to the acre than the best local canes in the Punjab, while another (CO 213) on an experimental acre at Pusa last year yielded nearly 60 tons of good quality cane.

The Spadework at Coimbatore.

This result has not been achieved without a lot of difficult and painstaking experimentation inaugurated some seven years ago at the Coimbatore Station by Dr. BARBER and continued to a successful issue by his one-time chief assistant and subsequently his successor, Mr. T. S. VENKATRAMAN. The obtaining of cane seedlings in a country like India is beset with peculiar difficulties. They have to pass through a long series of tests before they can be put into the hands of the cultivators. There are two equally important properties to test, the vigour and habit of the cane, and its richness in juice. Unfortunately these are generally mutually antagonistic in the cane, and consequently the vast majority of new seedlings have sooner or later to be thrown away. The few which survive have to unite the good qualities in themselves so as to be superior to the canes which have been gradually selected during many generations. Hence the period of necessary testing is a matter of years, and we believe Dr. BARBER himself

originally anticipated that at least seven would be needed for India, in which forecast he seems to have been pretty close to the actual achievement. In the particular case of India, it was required to supplant a hardy vigorous kind of cane possessing fair to good juice but much fibre by an equally hardy and vigorous form with better juice, a shorter growing period with earlier maturing, and above all a greater tonnage of canes. For this purpose the wild grass Saccharum was introduced into the combination and was crossed with a good comparatively hardy tropical cane which had been acclimatized for a century or more in Southern India, in which quarter the work had to be done for the sake of the flowering. Indian canes do not flower in the north and it was only after a year or two that they were sufficiently acclimatized in the south to do so there. Of course the seedlings are not all derived from *Saccharum spontaneum*, but have the most varied parentage. One of the difficulties has been that each tract in North India wanted a different cane, which was steadily held in mind at Coimbatore after studying the tract in question.

The Results Achieved to Date.

Having given a brief indication of the task that had to be undertaken by Dr. BARBER and Mr. VENKATRAMAN—a task, it may be added that was not rendered easier by the chronic apathy in Government quarters, culminating in the "damning with faint praise" of the Coimbatore station on the part of the Indian Sugar Commission[1]—we can turn to notice briefly some of the results achieved, now that the selected seedlings have been tried out on a field scale. It may be said at the start that the results have exceeded the most sanguine anticipations of the sponsors of the experiment. In the Report reproduced elsewhere details are given of the work undertaken by the Pusa Sugar Bureau in pushing these field trials to a successful issue; if these canes continue to maintain their reputation, they are expected to revolutionize the sugar industry in Bihar. The Bihar planters on their part are, we learn, so impressed that they have formed with others a company to grow a large area (40 acres) of the new seedlings, buying a mill in order to be able to make the sugar. They have also provided the funds to put a larger area under some of the Coimbatore seedlings for seed purposes. It is reported, though details are still lacking at home, that the final milling results were an astonishing success. Even in the United Provinces where the Shahjahanpur Research Station under Mr. G. CLARKE has been dubious in its attitude towards the Coimbatore experiments, the new seedling canes have justified further trial on a field scale, and the results at Bihar will doubtless induce the U.P. authorities to make a more thorough investigation than they seem hitherto to have undertaken. In view of the fact that the U.P. includes over half the total area of the sugar cane crop in India, it is most certainly incumbent on those in charge of sugar cane experiments there to leave no stone unturned to try out the new seedling canes thoroughly.

Apart from Indian opinion on these new seedlings, it is worthy of note that two experienced sugar men trained mainly under American cane sugar auspices who are at present in India, to wit Mr. NOËL DEERR and Mr. J. T. J. CROOKS, have expressed themselves optimistically regarding these canes. Mr. DEERR likened a field of CO 213 he saw at Pusa to a typical Java canefield, and found nothing to criticise save only the large percentage of fibre, but then low fibre canes will not grow in north India and Mr. DEERR would undoubtedly prefer a high yield with more fibre to a low one with normal fibre. Mr. CROOKS is

[1] See *I.S.J.*, 1921, 657.

convinced that the new seedlings will be the salvation of the sugar industry in Northern India and that Dr. BARBER has solved the Indian problem. The unanimity with which both indigenous and imported cane experts in India view these new seedlings is a refreshing feature and augurs well for the future of cane cultivation in India, always providing the seedlings maintain their initial characteristics.

Before concluding this interesting subject, we may be permitted to express the hope that the success achieved by the various Coimbatore seedlings will give pause to the somewhat ruthless use of the economizing "axe" on the Agricultural Department in India, and that the work of the Coimbatore station and the Pusa Bureau will not be crippled in any way. The area over which the improvement will have influence is not small, being well over two million acres, and there are said to be better canes still in process of testing. We are not clear as to the status of the experimental area in North India under Coimbatore seedlings, but trust that arrangements may be made for its continuance. And, in this connexion, we note that it is the Sugar Bureau which has interested itself in bringing the new seedlings to the notice of the planters, and all credit is due to Mr. WYNNE SAYER, the official running it, for first of all appreciating the possibilities of the seedlings and then taking them up from a business point of view, an aspect beyond the scope of the Coimbatore station. Without this assistance, it is likely that progress would have been much slower.

British Sugar Beet Agriculture.

We could only make a brief reference last month to the annual meeting of the British Sugar Beet Growers Society; but the speeches made at the subsequent luncheon were some indication of the improved outlook, politically speaking, of the industry and augured well for a sustained interest in the venture on the part of those in authority. It is therefore as well to summarize two of the principal contributions to the debate at the gathering.

The Permanent Secretary to the Ministry of Agriculture, Sir FRANCIS FLOUD, speaking on behalf of the Ministry, said that the British sugar beet industry was one in which for many years his department had taken considerable interest. They had helped to start the Kelham factory, and the policy of the Ministry had been to support the work of the company by every means in their power, while they had interfered as little as possible in its operations. They had supported the movement because from the agricultural point of view they believed there were few things that could be of greater assistance to the movement for maintaining and increasing the arable area of this country than the growing of sugar beet, from which there were very important agricultural benefits to be derived. They knew the benefit of successive crops in rotation and they estimated that an increase of 10 to 15 per cent. in a corn crop resulted from the inter-rotation of sugar beets. So far as the Ministry was concerned they looked forward with great hope to a large extent of beet growing; not only to a third factory being started, but to a larger number being formed in the near future.

The Chairman, Mr. G. H. ROBERTS (Labour M.P. for Norwich) welcomed the pending extension of beet sugar cultivation as one means of providing increased employment for the agricultural population. Moreover, he was imperialistic enough to believe that we ought to become increasingly self-contained as regards our food supplies. As Food Controller at one period, he learnt what it cost the country in its extreme dependence on outside sources of food supply. One of the greatest disappointments of his political career was the indifference of the town-

dweller to agriculture. Mr. BONAR LAW had frankly said the other day to a deputation of agriculturists that the only way to foster agriculture in this country was some form or other of protection, yet those of them who were convinced of that fact recognized that it was not politically possible unless and until the leaders of all political parties in this country abandoned their party aims and purposes and united with the single aim of promoting the prosperity and the stability of our country, which could only be secured by the development of a prosperous agriculture. Sooner or later we should be driven by some crisis to develop agriculture. He was a Free Trader, but whether Free Trader or Tariff Reformer, he was sure we should be driven, because every country in the world was proceeding to develop agriculture at whatever the cost might be, and the longer we postponed it the heavier the sacrifice the town-dweller would be compelled to make. Sugar beet in his opinion was one of the hopes of agriculture. It offered a sure crop to the farmer, it gave employment, and it added to the strength and stability of our country by diminishing our dependence on other sources.

New Beet Sugar Factories projected.

The third beet sugar factory above referred to is, we understand, to be erected on the Sudbourne estate near Saxmundham in Suffolk. Preliminary negotiations have already been made with farmers in the neighbourhood in the hope of getting a guaranteed acreage of roots for at least three years. This factory is planned to be erected on the Sudbourne marshes, where there is an abundant water supply and three neighbouring rivers are available for conveying roots to the factory; besides water transit, it is intended to employ motor lurries for conveying roots to their destination. Other details of the scheme include the provision of small slicing and diffusion stations (like the Continental *raperies*) at various points, whence the raw juice would be conveyed in tank waggons to the main factory. Another intention is to develop if possible a by-production of ethyl alcohol from the resultant molasses.

Another beet factory project is mooted in Yorkshire where very good roots can be grown, but details are not for the time being available. What is clear is that the severe depression in the agricultural industries of Great Britain which has been experienced for some months past and has caused grave concern in Government quarters, has acted as a fillip in drawing attention to the advantages of sugar beet growing as a paying crop for farmers—it was the only crop last season that appears to have paid well, and the propaganda of the British Sugar Beet Growers Society should now fall on much more willing ears than was the case a few years ago when the average British farmer was too conservative and too inclined to leave well alone to be induced to make a radical departure in his crop rotations.

Affairs in America.

The upward price of sugar which has been a feature of the markets in America no less than in other countries has lately induced the American Government, mainly for political purposes we suppose, to carry out certain investigations and also to arraign certain market operations before the law courts. The investigations were made by the Tariff Commission at the special request of President HARDING to determine whether the change in the import duty as revised under last year's tariff bill was in whole or in part responsible for the sharp rise in the price of sugar that began in February last. Raw sugar which was 3·16 cents, f.o.b. Cuba, on January 24th was 4 cents on February 9th, 5·10 cents on February 20th, 5·60 cents on March 14th and 5·85 cents on April 10th. The Commission found that the

change in the rates was not the cause of the rise in prices but that other factors (which they did not attempt to specify as being outside the scope of their investigation) controlled the advance. To quote their Report, "the statement that the American price of sugar for the time being includes the duty on sugar is not equivalent to saying that if the tariff were reduced or removed prices to the consumer would necessarily be lowered by the full amount of the reduction. If the American sugar tariff were reduced or removed, the tendency would be to reduce the domestic production of sugar and to increase the importation of foreign sugar into the United States."

The other action taken by the American Government has been to get the Department of Justice to try and obtain an injunction in the New York law courts against the New York Coffee and Sugar Exchange, Inc., and the New York Coffee and Sugar Clearing Association, Inc., to prohibite these bodies from further engaging in transactions in raw and refined sugar, on the alleged ground that as a result of fictitious transactions carried on by these defendants raw and refined sugar prices have been increased since February 7th more than two dollars per cwt. on the average, and that speculative operations carried on for the purpose and with the intent of unduly increasing the prices of sugar constitute an unlawful conspiracy in restraint of trade. In other words, the Government is trying to prove that dealings in futures on the sugar market are responsible for a large part of the recent rise in the price of sugar and not as might have been supposed the economic fact that consumption has overtaken production and there is a comparative scarcity of the sugar. As a consequence of this action (which was down for hearing about April 30th) the New York market was rather perturbed, but most dealers thought that no permanent injunction is likely to be granted because it is generally considered that in spite of their facilities for purely speculative dealings, the futures exchanges are economic necessities and act as stabilizers.

The World's Sugar Crops.

In view of the attention that has been given recently to the shortage of sugar supplies, it is convenient to analyse the latest figures of the world's sugar crops, as given on page 280, the estimates being Willett & Gray's. American cane shows a decrease in 1922–23 of some 140,000 tons as compared with 1921-22; but as the Cuban figure is still put at 4,000,000 tons, whereas Mr. HIMELY has reduced his estimate to 3,725,000 and Guma to 3,670,000 tons, the deficit would appear to be nearly treble. Apart from Cuba, it is due to smaller crops in Louisiana, Porto Rico and Hawaii, and to slightly smaller yields in a number of other crops, while Barbados, Peru, and Argentina show marked increases.

Asia shows about 400,000 tons increase, mainly due to India and in a lesser degree to Java, while the Philippines crop is smaller. Australia remains about the same with some 350,000 tons; Africa has 30,000 tons more, largely due to a big increase in Mauritius, where the crop is put at 233,000 tons as compared with 182,234 tons. Parenthetically, the 1923-24 Natal crop is estimated at 200,000 tons, or some 60,000 tons more than in the past season, when 141,260 tons was obtained, The total cane crops of the world for 1922-23 are estimated as just over 250,000 tons more than a year previously.

The European beet crops have increased by 553,869 tons, France accounting for the biggest increment and Sweden and Denmark for large decreases; American and Canadian beet suffered from a decrease of 300,121 tons. So the net result of the 1922-23 season is, as estimated by Messrs. WILLETT & GRAY, 508,932 long tons increase over 1921-22. But if Mr. Himely's estimate of Cuba holds good, the actual figure is more like 234,000 tons.

Fifty Years Ago.

From the "Sugar Cane," May, 1873.

A translation of a paper by SCHEIBLER, entitled "New Method for the Direct Determination of the Amount of Refined Sugar in Raw Sugar," was reproduced in this number of our predecessor, this being an essay in a competition for the solution of the problem of determining previously by analysis or otherwise the yield of white sugar which may be expected from a raw beet product. SCHEIBLER was an advocate of the so-called "mechanical theory" of the formation of molasses, and his ideas are now only of historical interest. He said that "it is an incontestable result of researches recently made . . . . . . that the formation of molasses is not due to the salts, as has always been supposed . . . . . Now it seems to be probable that the formation of molasses does not depend in general upon chemical phenomena, properly speaking, but that it constitutes a physical act, which, under given conditions, opposes itself to the crystallization of the molecules of sugar, and prevents them from precipitating in the solution . . . . . The molecules of sugar by reason of the presence of molecules of a different nature will be separated from each other by greater intervals, and will no longer be able to obey with the same energy their reciprocal force of attraction. Their crystallization will be slower. If now we eliminate from this solution of mixed molecules the crystals of sugar, the molecules not composed of sugar remaining in the molasses, it is clear that the molecules suffer a separation more and more considerable, which at a certain limit will render them incapable of exercising their reciprocal attraction efficaciously. Crystallization of sugar no longer takes place; molasses is formed . . . . . . These considerations have given rise to the hypothesis which may be used to measure the melassigenic value of a raw sugar by the viscosity and thick consistency of its solution . . . . . ."

SCHEIBLER therefore examined different methods of determining viscosity, namely the rate of flow from a tube having an orifice of a certain size, the duration of the oscillation of a needle swinging in the solution, and the determination of the size of the drops from tubes filled with pure and impure solutions; but he concluded that none of these methods was susceptible of giving practical results. His solution of the problem offered to the jury appointed to award the prize consisted of a process of washing the raw crystals with alcoholic wash-liquors, and he terminated his contribution by stating that he had been "in the highest degree astonished and satisfied at the extreme accuracy of the results obtained by the method thus modified."

T. L. PATTERSON published an interesting paper on the analysis of animal charcoal, emphasizing the value of determining the organic matter, which he pointed out "ought to be always accurately and separately determined, since it not only enhances the value of the analysis, but gives important information as to whether the char has been properly burned." At that time it appears that chemists determined only the carbon by treating the char with hydrochloric acid, and weighing the residue on a tared filter. On the other hand, he advocated that the organic matter should be determined by igniting the char, and deducting the water and carbon from the loss thus found.

Lastly, it is of interest to note that W. EATHORNE GILL advised at this remote time the filtration of the whole mill juice (through sand) before passing it to the evaporators "to keep back the *cush* before it can be softened by boiling," having found that a superior quality of juice and of sugar could be thus produced.

The Sugar Duty.

Parliamentary Debate covering the Budget.

In introducing his first Budget to the House of Commons last month, Mr. Stanley Baldwin, the Chancellor of the Exchequer, when he came to refer to the sugar duty said he had thought it important to investigate carefully how far in the present condition of the world's market the consumer could be expected to retain the advantages of any lowering of the sugar duty; but it was evident that the sugar market today was a seller's market owing to the anticipated shortage of the world's supplies, hence although it was practically certain that a reduction of duty would be at once accompanied by a proportionate reduction in price, he thought it highly improbable that the consumer would be the gainer for more than a very short time. The reduction in price would lead to an increased demand which would tend further to increase the world's price and the result would be that the money sacrificed by the Exchequer would go straight into the hands of the producers and dealers in sugar. It might be argued that even if prices did rise they would still be lower by the extent of the reduction of the duty. In his opinion this would not follow, as the increased demand following an immediate reduction in price would be bound to lead under present conditions to a greater increase in price than would otherwise take place. In these circumstances he had with great reluctance refrained from proposing any reduction in the sugar duty. But it was his sincere hope that the position of the world's markets would be such that a reduction might be justified at an early date.

In the course of the subsequent debate, a number of the speakers expressed regret that the sugar duty had not been chosen for a reduction. Mr. Ramsay Macdonald thought the existing duty bore heavily on those of the population who were struggling every week to make ends meet. Sir Alfred Mond was inclined to doubt Mr. Baldwin's premises as to the probable incidence of prices following a reduction. Mr. Asquith averred that sugar should have been chosen in preference to beer as an object for reduced taxation; sugar, he added, had brought down many Governments, and so for that matter had beer. Sir Robert Hamilton enlarged on the universal consumption of sugar throughout the land and its utility to the wellbeing of the people; he also argued that a reduction in duty would help the allied trades in which sugar was an ingredient. But on the whole Mr. Baldwin's decision was accepted as an inevitable necessity in the present circumstances.

Two days later when the debate on the Budget was continued and the Labour party made a renewed attempt to get the sugar duty reduced, Mr. Baldwin returned to the subject in his reply and elaborated his previous arguments for believing that a reduction at the present moment would fail to benefit the consumer. He said: "When I first began to examine the Budget position there was no article that I was more anxious to relieve . . . . But I think it is a useful thing to remember, in the first place, what the consumption of sugar is in this country. In 1913 it amounted to 83 lbs. per head. During the period of control following upon the war, it fell considerably. When control was taken off in 1922, even at the high prices then ruling, and even with the present duty, the consumption per head was no less than 75 lbs. Next consider the figure of world production. The world production in the two or three years before the War was 18,500,000 tons, and out of that Europe, with its beet sugar, produced over 8,000,000 tons. For the current year the sugar production is just under 18,000,000 tons, and such stocks as are carried over from year to year are already

being eaten into by the demand. Now the position is a very different one, for in the intervening years the centre of gravity has shifted to America. The European beet sugar production, which was just over 8,000,000 tons in 1913, is now down to just under 4,000,000 tons, whereas Cuba, which formerly produced 1,500,000 tons, on account of the preference she has had in the United States, has increased her production to 4,000,000 tons. Finally, while our consumption, although below that of pre-war days, is yet approximating to it, American consumption has gone up by leaps and bounds, partly due to the increase of population and the increase of wealth in that country, and partly due to the increased amount of sugar which the human system seems to require when deprived of alcoholic liquor. In passing, may I advise the Committee to wait for complete prohibition in this country until there is once more a surplus of sugar, or they may find that by giving up alcohol and taking to sugar they are indeed casting a real burden on the masses of the people.

"Having given those figures, I wish to call attention to the price of sugar. Fifteen months ago the price of raw Cuban sugar was 10s. 6d. a cwt. One effect of that cheap price was to prevent any increase in the already enormously reduced sowings in the European beet countries, and those low prices held for some little time. But gradually, all through 1922, the price crept up as the dealers saw a possibility of world consumption catching up if not overtaking the world production, and in January, 1923, the price was 17s. 6d. per cwt. It remained there or thereabouts for about three weeks, when it became obvious that the Cuban sugar crop was going to be far below the estimate, and prices then began to move up strongly. They moved up almost week by week until yesterday the price was 30s. 3d. per cwt., or three times more than the price in January, 1922. This rise has been caused entirely by the fact that so far as can be seen there is actually going to be a shortage of sugar this year and the slightest increase in the demand may easily cause a panic and send up prices rocketing far beyond the present price. This position is well known in commercial circles. But I have information that the increase of sowings in the Continental countries of Europe, stimulated by the high prices, is as much as from 25 per cent. to 40 per cent., so that, as far as we can see, by the turn of next year the world price of sugar should be lower, and when this happens, that will be the time to reduce the duty. If I were to reduce the duty in this Budget, the whole of that reduction would go straight to New York, and I am not going to do it. It would be a very easy thing for me to have proposed this reduction, and to have said in public that sugar was cheaper by the reduction of the duty. Let those hon. members who might have believed that to be true say it, but I do not believe it to be true, and, therefore, I am not going to say it."

There was no opportunity for putting to the vote the opinion of the House on the sugar duty, as it is not an annual one and unlike the tea duty does not need a resolution of the House approving of it. But when the subject comes up later on in the session in the course of the Finance Bill debate, it is quite likely the House will be divided on the question.

Dr. H. F. BREWSTER states that an experiment is in progress at Audubon Park, La., in order to determine the possibility of destroying cane borer with the aid of heat. Plant cane was dipped into water heated to about 60°C. (140°F.) for 20 min., which killed all the borers, mealy bugs, etc., then present, after which the cutting was planted in the usual way. On comparison with cane which had not thus been treated, it was found that the heating had hastened germination to a great extent, the heated cane being some 6 in. higher than the other. It remains yet to be seen whether the heating process will prove effective in keeping the cane free from borer molestation during its subsequent development until harvested.

British West Indian Sugar Factory Conditions.

It is unfortunate that in a year when prices for sugar promise good returns to the sugar manufacturer, the weather conditions should interfere with the agricultural side of the industry in the British West Indies. Thus in Jamaica, Trinidad and some of the northern islands the crop will be short owing to drought. On the other hand, British Guiana had far too much rain at the end of last year, resulting in miles and miles of floods. This contretemps strengthens the view of those who hold that this colony will never be secure with its sugar industry till the estate owners "take the bull by the horns" and put down large drainage pumping plants capable of quickly lifting these periodical flood waters into the large rivers, and send them out to sea at any state of the tide.

In Jamaica the drought has burnt up the fields badly and in many parts it is doubtful whether it would pay to reap the crop. But fields apart, the factory work at most of the places in this island leaves very much to be desired; the milling plants are indifferent and the boiling-house arrangements totally at variance with what a modern sugar factory should possess. This state of affairs is mainly due to the fact that in times past the Jamaica sugar producers have cared little about boiling-house efficiencies, since rich molasses and scums went on to the distillery and often fetched more money as rum than they would have done if they had been more completely exhausted of their sucrose. But now that rum is out of the running (largely due to prohibition in America having cost the distillers their largest market) the sugar factories must find themselves in a bad plight, and if their owners are to continue in the sugar business and make good, they will have to take early steps to re-arrange their boiling-house plants on modern lines.

The one exception in the island is the splendid electrically-driven factory supplied by Messrs. George Fletcher & Co., Ltd., to the Grays Inn Central Factory Company and installed at Annotto Bay some two years ago. This factory has a capacity of about 1000 tons of cane per 24 hours, and is thoroughly modern and up-to-date in every respect, the whole of the motive power being electrical, generated through three 500-kilowatt steam turbo-alternators supplied by an American firm. Two of these generators operate the factory, while the third is in reserve. They have also a modern French still for turning out 98% alcohol from the final molasses.

Unfortunately, owing to the price slump of the last two seasons and to the recent drought, their cane supply this crop is very poor, and as the Bernard Lodge factory has also a short crop, it has been decided to grind the Grays Inn Company's cane at the former factory. Next year it is hoped there will be cane enough round Grays Inn factory to justify the latter going into operation again.

Turning to Trinidad, it may be mentioned that the St. Madeleine Sugar Company has recently purchased La Fortuné estate and factory, formerly belonging to Messrs. Chas. Tennant & Co., but more recently in the possession of Messrs. Gordon, Grant & Co., of Trinidad. The purchase included the present crop, estimated at 45,000 tons of cane, and this is now being ground at the St. Madeleine factory which during the past two or three years has not had sufficient cane to keep them at full capacity.

The juice all over Trinidad is very good this season, both as to purity and to sucrose, and this will help to make up for the low cane returns owing to the repeated drought. St. Madeleine is making a part of their crop into plantation refined and granulated sugar; they are using the Bach process, and so far, we understand, the sugar turned out has proved very good and compares favourably with the standard granulated imported from Canadian and U.S. refineries.

The Antigua Sugar Company in the Leeward Islands has also installed a separate refining plant at their factory, and intends to turn out plantation refined sugar by the same Bach process before this crop season is far gone. The St. Kitts Factory Company have extended their railroad about 11 miles around the north-western end of the island, and are also receiving cane from the west coast estates by means of sea transport; and in spite of the havoc wrought by the drought (practically no rain having fallen since October last) they hope by this means to attain very nearly to their normal output of sugar. They are now receiving cane from every estate in the island, and the planters are very glad to be relieved of their one-time muscovado troubles, and the uncertainty of the syrup market. In St. Kitts likewise, as in Trinidad, the juice is above the average, and this circumstance will help to make up for the shortage of cane. Up to October last the crop promised to be a record one, but from that date onwards practically no rain fell, and the crops as a consequence fell off tremendously. As an instance, two estates near the factory capable of 20,000 tons of cane will this year send in barely 5000 tons. There have been a few instances of mosaic disease, but these have been drastically and promptly dealt with.

As for Barbados, it is having a splendid crop, not a record one it is true, but one over the normal, being estimated at from 65,000 to 70,000 tons of sugar. This, with the good prices now ruling for sugar, will put the planters in a handsome position financially and prevent them for the time being from feeling the want of co-operation on a larger scale; but sooner or later keen observers consider they will find they were unwise in installing during the boom years so many toy plants instead of combining and putting down larger mills and light railways. Eight and eleven, and, as happened in one case, even fourteen-roller plants with rollers 22 in. × 36 in. or 24 in. × 42 in. can hardly be considered economic dimensions from a modern standpoint.

In this island the canes arrive at the factories in all kinds of carts and conveyances, making it impossible to arrange for any form of mechanical unloading device (not one factory is so fitted), and the cane is dumped in heaps all over a large yard while the cane carriers are fed by hand. It is true that labour is cheap and plentiful at the present moment, but what about the future? The time will come in all probability when these factories will feel the disadvantage of not possessing light railways and mechanical devices for loading the carrier. Those proprietaries then that take advantage of the large profits promised by the present and probably the next crop to remedy this defect, will undeniably score over their neighbours when once more production overtakes consumption and sugar prices drop for the time being, for a low cost of production will then be an important consideration.

St. Lucia has a very short crop this year, owing in part to drought and in part to monetary stringency amongst the estate owners, but the good prices expected should enable them to redeem bank loans and leave them something over to get ahead with better cultivation for the next crop. The three or four factories in this island are, it must be confessed, rather indifferently fitted, having in most cases eight-roller mills of ancient make.

In St Vincent there is talk of a small central factory to serve the Buccament Valley and the two or three smaller valleys on either side. The proposals have merit in them and could be made a success in the opinion of those best able to judge. Such cane as was available would be of good quality as it would be mostly hillside cane, and altogether about 25,000 tons might be counted on from growers of the small estate type, and a further 5000 from the less dependable peasant

growers. The local government is said to be very sympathetic to the proposal and is seeking authority from the Colonial Office to guarantee interest and sinking fund on one-half of the required capital.

Entomological Work in the Queensland Cane Fields.

The Report of EDMUND JARVIS, the Entomologist dealing with pests in the cane fields in Queensland, for the year 1922,[1] gives a very concise summary of the work being carried on there. This branch of study in the cane fields is becoming increasingly important in many sugar cane countries, not only where the introduction of the crop is comparatively new and grows on land recently cleared of forest and grass, as in Hawaii and Queensland, but also in such old established cultivations as we meet with in Barbados, Porto Rico and Egypt. During recent years an extensive literature has gradually accumulated regarding Queensland sugar cane pests, and this from two points of view. In the first place descriptive lists have been compiled, illustrated on a liberal scale, of all insects injurious to the cane plant; and, in the second, a much greater number of papers have appeared dealing with the intensive study of those forms which have assumed or may assume a threatening predominance. The present report is in the latter category, and attention is confined to the economic study of the control of four destructive forms. Two of these are cockchafers, the grubs of which, living in the soil, eat off the roots and sometimes also attack the young underground buds and shoots; these are named respectively *Lepidoderma albohirtum* and *L. frenchi*, and differ chiefly in the length of their life history, carrying with this differences in the nature of the injury effected. The other two are borers, tunnelling the stem, chiefly in its lower parts, the damage being mostly due to the larvae which lives entirely inside the cane. One of them is a beetle borer, *Rhabdocnemis obscurus*, and the other a moth borer, *Phragmatiphila truncata*, which also destroys a number of young shoots by boring inside them. But vastly the greater amount of literature deals with the "white grub," a term applied to the soil grubs of *Lepidoderma* and allied forms, and especially of *L. albohirtum* commonly called the "grey back."

The work of the year includes efforts at control along the following lines :— For the grey back, fumigating the eggs and the grubs with carbon bisulphide, the trial of dry fumigants, soil repellants and poison baits, the spread of entomogenous fungi and bacterial diseases among them, and the continued multiplication of parasites and the introduction of new ones into the country ; for the adult beetles, trap trees and crops, attracting the beetles by aromas, and poisoning their natural food trees. The beetle borer is collected, in the adult stage, and a tachinid fly parasite is being reared and distributed to hold it in check. The moth borer similarly is countered by spreading an indigenous braconid wasp parasite of local occurrence to all tracts affected where it does not appear to be present. The work of the section has increased to such an extent that in 1921 an assistant was appointed, and another is immediately wanted in view of the usefulness of the work already accomplished by the first one. A small museum has been started in connexion with the Meringa laboratory, which is devoted entirely to entomological studies, and sets of the chief cane pests have been prepared, showing the

[1] Annual Report of the Bureau of Sugar Experiment Station up to 31st October, 1922. H. T. EASTERBY, Queensland, 1922.

various stages in their life histories, both in health and disease. To these are added photographs, and a set of coloured charts has been prepared for general educational purposes. With this equipment it should be easy for any cane cultivator rapidly to become familar with all the insect pests which are likely to occur in his plantation.

CONTROL OF THE WHITE GRUB.

Fumigating the living eggs of the grey back was tried by injection of carbon bisulphide into the soil near them, at distances varying from 4½ to 8 in. By the third day, while the control eggs had grown in size without change of colour, those treated had not altered in size, had lost their creamy colour and had assumed a dark brown tint, at the same time being enveloped partially by a whitish mould. It is considered that they had been killed shortly after the injection had been made.

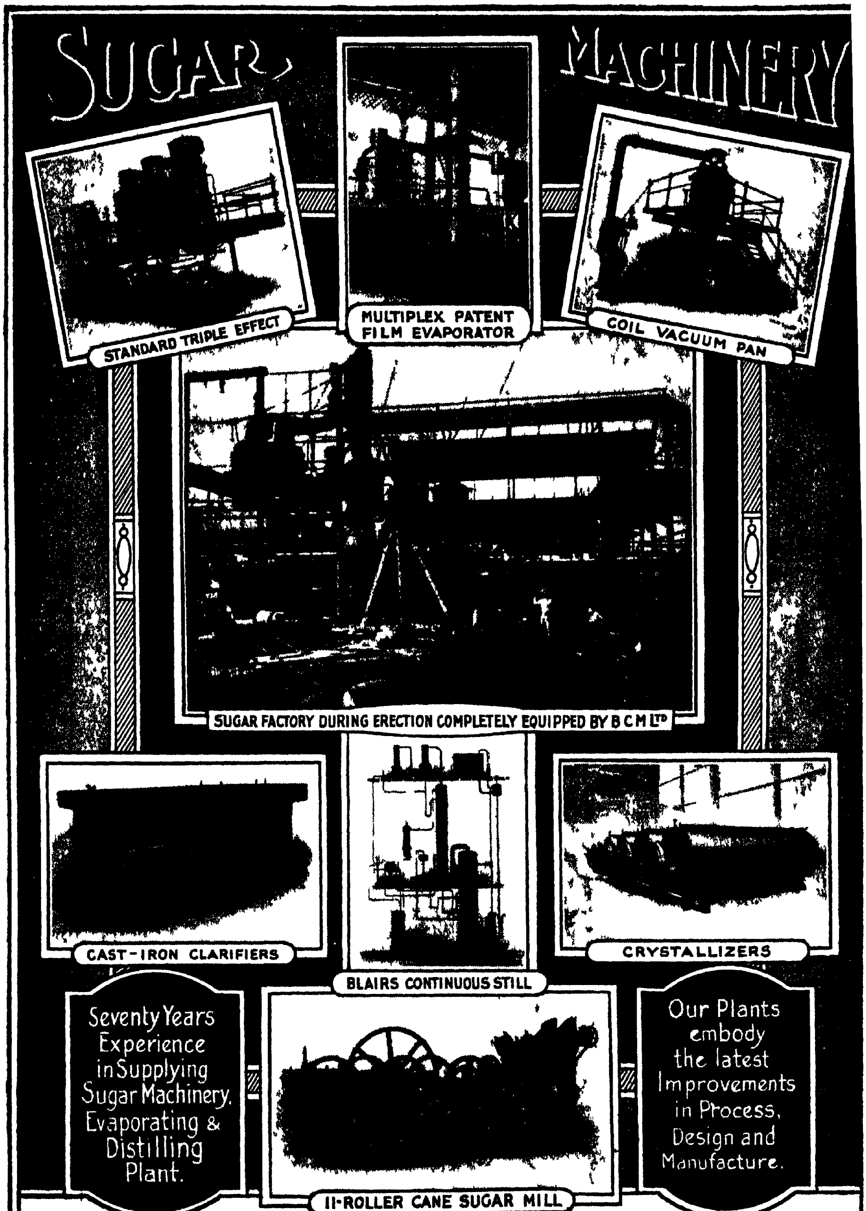
The success of fumigating the grubs with carbon sulphide appears to depend upon the time of application and the friability of the soil, together with its content of moisture. Excellent results have been obtained in certain cases, but in others, although all the grubs have been destroyed, the plants had reached a stage when they were unable to form new roots to replace those that had been eaten away. A machine for the rapid distribution of the fumigant, invented by a planter, was tried, but was unsuccessful apparently because no arrangement had been provided whereby the injected fumigant could be covered up and thus kept in the soil.

Dry fumigants, such as naphthalene, pungent oils and poisons, gave good results in the laboratory, but were less successful than anticipated in the field. The most promising appears to be a substance rejoicing in the name of paradichlorobenzine. Special study is still required in the field as to the rate of evaporation and penetration of the fumigant in clays and other close packed soils, during rains and at different temperatures. It has also to be determined whether the fumigant has any deleterious effect upon the young roots of the cane.

Various insecticidal substances were sprinkled on the soil as repellants, to induce the egg laden females to lay their eggs elsewhere. Tar, naphthalene, chloride of lime, tobacco juice and carbolineum emulsion were tried on plots the eighth of an acre in extent, each with a similar control plot. The odour of the repellant was noted for from nine to fourteen days after application. Little difference was noted in the crops however, except that the plots treated with naphthalene and carbolineum soap emulsion had straighter and taller plants upon them than the respective control plots. No positive results can however, at present, be claimed.

Work was continued on the spreading of the muscardine fungus (*Metarrhizium anisopliae*); and three bacterial diseases were observed, all of which appear to promise usefulness from the preliminary experiments. Cultures of the latter on slices of potato caused the death of healthy grubs in a few days. In experiments with poisons, aceto-arsenate of copper gave the best results; this is easily the most deadly of the cheaper forms of arsenical poisons.

Of trap trees and crops, *Ficus pilosa* and *F. nesophila* are greedily devoured by grey back beetles, and such trees are recommended for planting near the head lands, where collecting the beetles is undertaken. They are easily propagated by cuttings and should be trimmed so as to form a low spreading habit, other vegetation being cut out as much as possible. Observations on the poisonous effect of the foliage of certain trees suggest the planting of these also. A kind of persimmon was sent in, with the reputation of being poisonous to the beetles, but as expected a trial showed that no harm overtook the beetles fed upon it.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There is good reason for supposing that the sense of smell is highly developed in these beetles, so as to guide them quickly to the spot where females are to be found or where their favourite food trees grow. On trial, it would appear that there is a curious selection exercised by the beetles in their choice of perfumes; thus, while cajeput oil, acetic and carbolic acids, nitrobenzene and oil of almonds were objected to, oil of cloves, fish oil and formalin were encountered without any signs of repugnance. Their unerring flight to their favourite Ficus plants, even when isolated, or in the midst of other food plants, suggested the preparation of compounds or mixtures simulating in smell these food plants, and a series of small tins has been prepared containing such substances together with others reminiscent of decaying vegetable matter, and these will be utilized during the present season. The idea is to attract the females, before they visit the fields to lay their eggs, and either collect them or poison them by appropriate methods. This collection of beetles has unfortunately been given up in some places, but there are others where the planters are still keenly alive to its advantages as a method of control.

As to poisoning the beetles, five sets of experiments with leaves sprayed with various arsenical solutions have been elaborated, and the times have been noted in which it is usual for the poison when eaten to cause death. Paris green with lime was the most rapid in taking effect, and death followed in four to seven days. The general average with 50 per cent. of the beetles fed was to die in two weeks. Those living longest were the beetles which had not eaten anything and these did not die till sixteen to twenty-four days after introduction into the cages.

Meantime a keen look out is being maintained for new parasites, especially scoliid wasps; and arrangements have been made with Java to exchange Campsomeris digger wasps for new scoliids which attack the cockchafers on that island, but are not present in Queensland.

With this large programme of work on the control of the grey back, it is not surprising that there is much less variety in the experimental study of the other major pests. In both of these cases control measures were confined to the search for, multiplication and distribution of parasitic insects. In the moth borer a braconid wasp, first found in 1919, was again sought for, and rediscovered in December, 1921; by the 25th of that month 203 wasps were obtained. Its life history was found to be only three weeks long and the female was noted in some cases to lay nearly 100 eggs. It is not surprising therefore to find that where it is present the moth borer is not wont to be a serious pest, and the hope of controlling it in badly infested regions is distinctly bright.

The beetle borer is regarded by JARVIS as "second only in economic importance to the notorious grey back," and continues to give trouble in many localities. Its prevalence in the Herbert river district induced the Colonial Sugar Refining Company to establish a breeding base for rearing its parasite, *Ceromasia sphenophori*. It has also been successfully established in the Gordonvale area and work is being rapidly pushed on in other centres, in collaboration with the local managers. A setback was experienced when a spell of wet weather caused the destruction of some 200 of these useful flies in the breeding cages, owing to attacks of a minute fungus, *Empusa*, a form of which causes in temperate regions the whole of the houseflies of a district to die in a very short time. It is surmised that this liability to disease will act as a factor controlling the usefulness of this parasite during the wetter months of the year.

C. A. B.

Review of Sugar Cane Agricultural Operations in India, 1921-1922.[1]

The area under sugar cane fell from 2,566,000 acres* in 1920-21 to 2,381,000 in 1921-22, but the estimated yield of *gur* (unrefined sugar) increased from 2,522,000 tons* to 2,591,000 tons. The outturn per acre works out at 2439 lbs. of *gur* as against 2202 lbs. in the previous year and the last decennial average of 2327 lbs.

During the year under review, India manufactured 73,113 tons of refined sugar in her 29 modern factories, an increase of nearly 6000 tons over the output in the previous year. Together with her production of refined sugar by the indigenous process of sugar-making which is estimated at 50,000 tons, a total of 123,113 tons refined sugar was manufactured in the country.

The imports of refined sugar, both in quantity and value, reached figures unprecedented even in the pre-war era. They amounted to 718,000 tons, valued at no less than 26¾ crores of rupees as compared with 237,000 tons, valued at Rs. 17 crores in the preceding year and the pre-war average of 634,000 tons, valued at Rs. 12½ crores. While a main contributing factor to the increased imports was undoubtedly the fall in prices, the fact that the country can afford to spend 26 crores of rupees in a by no means unusually good year should be a good enough guarantee of an assured market to capitalists desiring to promote the white sugar industry. The enhancement of the import duty from 15 to 25 per cent. and the rise in railway freights from the ports should give an additional impetus to the development of the home industry, and it is to be hoped that some at least of the nine new joint stock companies registered during the year for sugar manufacture will begin their operations at an early date.

Sugar is the only agricultural product in India in which the balance of trade is decidedly against her. Considering the area under the crop she should be at least self-supporting, and there is now sufficient evidence that, provided with the proper varieties of cane, and through adopting the right class of manuring, it would be quite possible to grow all the sugar cane required to meet the existing demands for both *gur* and white sugar on the present area. The problem would thus seem to resolve itself into this: is it possible to have a *gur*-making and white sugar industry alongside each other in the cane-growing areas? Otherwise it is at present quite out of question for the grower to deal with a large increase in outturn except by reducing his area.

The hope of effecting the desired improvement in outturn through improved varieties has received a remarkable stimulation by the results of the work of Dr. C. A. Barber, late Imperial Sugar Cane Expert, at the Coimbatore Cane-breeding Station—results which are just beginning to show the enormous possibilities in this direction. For example, one of the Coimbatore seedlings (Co 205) is already giving 60-80 per cent. higher yield of *gur* to the acre than the best local canes in the Punjab. The most important development is, however, expected in Bihar where the early ripening qualities of Co 214 and the high tonnage, combined with good agricultural characters, of Co 213 will not only enable the large number of sugar factories situated in this province to open their campaign at least a month earlier, and so provide them with a longer working season, but also increase the supply of the raw material.

[1] Taken from the Annual Review of Agricultural Operations in India issued by the Agricultural Adviser to the Government of India, Pusa, (January, 1923).

* Revised figures.

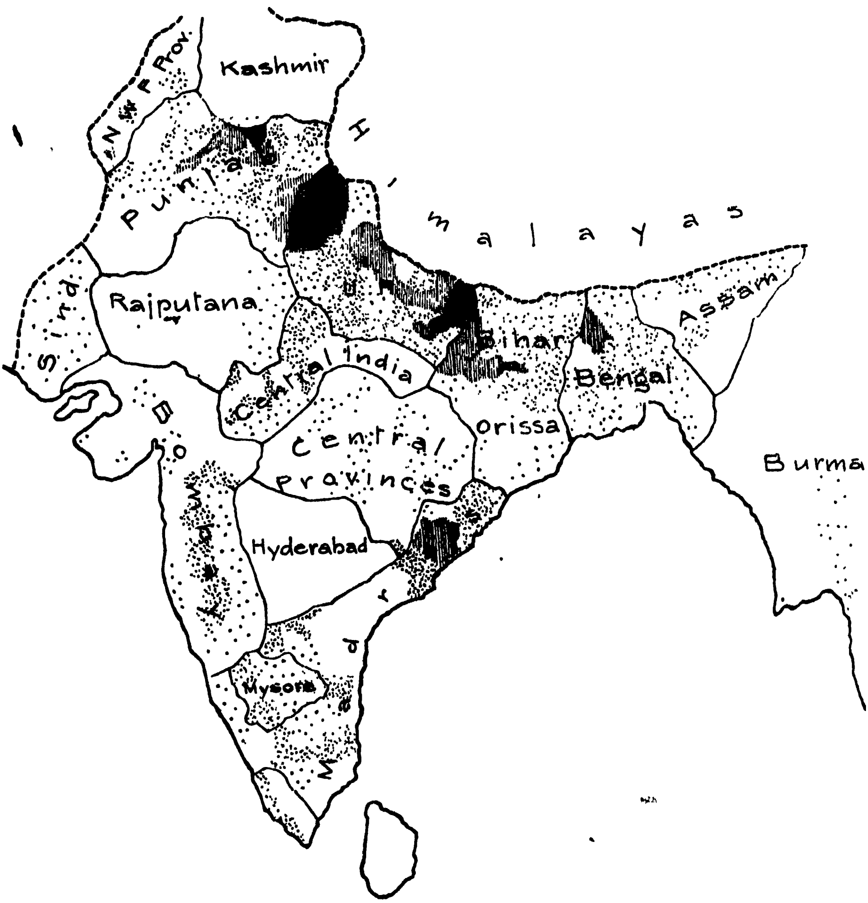
In North Bihar sugar cane is grown without irrigation and has to go through several months of intense heat and drought before relief comes with the monsoon. The Coimbatore types referred to above are not only good drought-resisters but thrive uncommonly well in the dry heat. They have also proved themselves excellent doers in low-lying semi-waterlogged areas, due, apparently, to the start they make before waterlogging conditions are established. Co 213 is especially vigorous and stands heavy manuring without lodging. The best acre at Pusa this year ran to 1600 maunds or nearly 60 tons of good quality cane without any lodging whatever and without trench planting—an important consideration in Bihar.

The Sugar Bureau established at Pusa continued to carry on its principal function of supplying information to the sugar industry in all its aspects, and of promoting sugar growing in India generally. It has also recently taken over the testing and multiplication of improved varieties for the surrounding district and of arranging mill trials of the more promising varieties. The first trials of the new seedlings have been quite satisfactory, and both factories and growers are doing their utmost to assist in the rapid propagation of Co 213 and 214, as it is recognized that these will, if they continue to maintain their reputation, revolutionize the industry in Bihar.

Over half the total area under the crop in British India lies within the borders of the United Provinces. Experimental work was continued at the Shahjahanpur Research Station. Three distinct lines are being followed in obtaining canes suitable for the various types of cultivation practised, viz., the importation of canes from other countries, the investigation of Coimbatore seedlings, and the isolation of pure lines of indigenous canes. All of them have given definite results, and three canes (S 48, Co 214 and A 42), which possess qualities justifying their introduction, have been selected. A 42, a thin cane which matures early, is in great demand both on account of heavy yield and the excellent quality of its *gur*. The selected Coimbatore seedling is also an early ripener and can be intensively cultivated without deterioration in quality. It, however, gives a slightly darker *gur* than the best canes, and arrows freely, which is not liked by cultivators. A field of 3·3 acres grown with S 48 gave last year *rab* which was sold for Rs. 3280. The improved methods of cultivation worked out on the farm are being gradually adopted where facilities exist for irrigation. The profitable cultivation of cane in this province is primarily a question of water, and, with the introduction of the Sarda Canal, a large extension of cane in Rohilkhand, which is to be organized as a distinct agricultural circle, may be anticipated.

As the result of observation and chemical analysis all but 24 of the large number of varieties of cane grown at Sipaya in Bihar and Orissa have been discarded, and the remainder are being tested with a view to further elimination and to discovering their response to manuring and to different methods of cultivation. Of the Coimbatore canes, Nos. 214, 213, and 210 are promising for early, mid-season and late cutting. These canes are being rapidly multiplied for distribution in North Bihar. Among the earlier tested canes, Saretha is the heaviest yielder of sucrose and has become popular among cultivators in the neighbourhood of Sipaya. At Ranchi, varietal tests of thick canes are in progress on thoroughly drained land. Java Hebbal was found last year to have the best sugar content, and, as it is among the hardy heavy yielders, it may displace J 247 for distribution. Co 213 promises exceedingly well as a drought-resister and heavy yielder, and the Pusa experience of its capacity to stand water-logging has been confirmed. The Mungo variety is gaining ground in the Orissa circle.

An increased inclination towards sugar cane cultivation is reported from Bengal, but irrigation difficulties in most areas would appear to limit the rapid expansion of the crop. Yellow Tanna has now established itself as an all-round superior cane, and the demand for sets is so great that it is impossible to cope with it. The McGlashan furnace from the Central Provinces, when tried at Dacca, proved more economical in fuel than the local type. An adaptation of the design to suit the date sugar industry has been brought out.



SUGAR CANE MAP OF INDIA.

In Assam, the testing and selection of varieties (local and exotic) under chemical control was continued in Jorhat. In addition to the four varieties previously selected (Striped Mauritius, B 147, B 376, and J 33*a*), two new ones, Co 9 and D 74, were this year distributed for the first time. Twenty varieties ratooned on the farm gave an average crop of 25 tons per acre, the highest yield being from B 3412. The same cane also topped the list as a plant crop with an outturn of 45·8 tons. But as regards quality, A2*a* returned the highest record of sucrose in the expressed juice, closely followed by Co 9. Of the new varieties,

A 2*a* and Co 9 promise to be valuable to sugar estates, while D 74, J 213 and B 3412 should do well with the ryots' conditions. The 3-roller iron mill and the shallow iron pans are both gaining in popularity.

A new development in Burma is the proposed sugar cane farm at Pyinmana. Of the eight exotic and two indigenous canes under trial at Tatkon, Java Hebbal, J 213 and Ashy Mauritius did particularly well. The latter was also most successful of the 13 exotic and two Burmese varieties grown without irrigation at Hmawbi, and all available cane of this type was sold for seed. The cultivation of sugar cane is rapidly extending in Shwebo, Sagaing and Mandalay. The departmental *jaggery* factory near Hopin has been dismantled, as the locality has been found unfavourable for such an enterprise, and it is hoped to find a more promising centre for future experiment either in Yamethin or Toungoo.

In the Punjab, the Coimbatore seedling 205, which did so well last year at Gurdaspur, has repeated its performance at Hansi.

At Tarnab in the north-west frontier province, 246 Assam Red has proved a better variety than the local Pounda. It flourishes with less irrigation, it yields better, it is less affected by cane borers, and withstands frost as well as the Peshawar variety. Having a hard rind it is not attacked by the jackal, and at the same time its seed keeps perfectly in the clamp. About 150 tons of sets have been given away for trial in the neighbourhood, and 15 acres are being grown this year for further distribution.

The long continued work at Manjri in the Bombay presidency on the testing of new varieties is now bearing fruit. One of the selections (Manjav) is proving itself of great value for water-logged areas under the canals in the Ahmednagar district, while another (Red Mauritius) is rapidly displacing the local variety in Kanara, on account of the facility with which it gives high yields in the ratoon crop. In South Surat, several of the Manjri types are in keen demand to replace the local Malbari, as they give higher yields and are less susceptible to red rot. Sulphate of ammonia, which has proved cheaper, value for value, than any other nitrogenous manure, is rapidly growing into use, its consumption in the Deccan being now between one and two thousand tons per annum.

As recommended by the Sugar Committee, experimental work on cane in the central provinces is now confined to the Tharsa farm. Of the varieties received from Coimbatore, Nos. 204 and 210 topped the list in the varietal tests; they gave yields of 8200 and 7330 lbs. of *gur* per acre respectively. The results of the manurial experiments show that for this crop a heavy dressing of dung or other bulky but slow-acting manures does not by itself give a maximum crop. To get a really bumper crop it is necessary to supplement it with a top-dressing of oil-cake, sulphate of ammonia, or other quick-acting nitrogenous manure. Compost made on the Adhartal farm from weeds, the sweeping of the threshing floor, road scraping, etc., proved a valuable manure for the crop.

Varietal tests carried out in co-operation with cane-growers in the Circars have established the superiority of J 247 over previous importations made in the Madras presidency. Java Hebbal has proved itself equally promising in the South Arcot cane area as well as on the West Coast. In manurial trials at Anakapalle and Samalkota, fish guano established its superiority. A cheap and efficient method of propping sugar canes against lodging during heavy winds has been adopted at the Sugar Cane Breeding Station through the adoption of galvanized wire in the place of trash and rope.

Sugar cane breeding work has furnished the Mysore State with at least one cane of outstanding merit, viz., HM 544. It is now grown in practically all the

main sugar cane areas, and is estimated to give increased yields of Rs. 150–300 per acre. A number of other seedling canes are under comparative test on a fairly large scale. Ammonium sulphate has been found to be a cheaper manure for sugar cane than any of the oil-cakes at present prices, and its popularization is being energetically carried on.

In Travancore, Red Mauritius continued to give the highest yield on the State farm. The manure recommended to the ryots is a mixture of oil-cake, fish guano and ashes.

The borer is the most serious pest of the cane sugar crop. Trapping of the moths in heaps of trash is carried on successfully in some localities, but against pests which possess means of rapid dispersal only concerted action on an extensive scale can bring relief. At Pusa, termites attacking growing sugar cane were checked by the application of crude oil emulsion with the irrigation water.

Tank Run-off Outlets.

By P. H. PARR.

With the small tanks used in the older sugar factories, the run-off outlets were settled more or less haphazard, and were usually anything from 2½ in. to 4 in. diam., but with the large tanks now in regular use it is often advisable to consider the diameter of the run-off outlet in connexion with the time taken to empty or partially to empty the tank.

If the height of the liquid in the tank (above the outlet) is h ft., then, theoretically, the velocity through the outlet is $8\sqrt{h}$ ft. per sec., and if we allow for a normal coefficient of discharge of about 60 per cent., we may say that the actual velocity will be $5\sqrt{h}$. During the time of discharge the head is, of course continually varying, and this is the point which introduces the difficulty into the calculation. To allow for the continual variation of the head involves the use of a little of the integral calculus : the details need not be considered here, and the result is, that if A_0 is the horizontal area of the tank, and A_1 the area of the outlet, both in sq. ft., then the time in seconds to empty the tank, with an initial depth of h ft., is :—

$$\text{secs.} = 0{\cdot}4\,\frac{A_0\sqrt{h}}{A_1} \qquad (1)$$

For practical purposes it is convenient to consider a basis tank area A_0 of 10 sq. ft., to take the outlet area A_1 in sq. ins., and the time in minutes, when :—

$$\text{mins.} = \frac{9{\cdot}6\sqrt{h}}{A_1} \qquad (2)$$

The accompanying table gives the time in minutes, as calculated from (2), to empty 10 sq. ft. of tank area, with an initial depth of h ft., through outlets of various diameters.

A few examples may help to show the use of the table. Consider a subsider 8 ft. × 5 ft. × 4 ft., with a 3 in. run-off: the tank area is 8 × 5 = 40 sq. ft., or four times our basis of 10 sq. ft.; the tabular value for a 3 in. outlet and 4 ft. depth is 2·72, so that the time to empty the tank will be 4 × 2·72 = 10·88 mins., or say just under 11 mins. With a 4 in. outlet the time will be 4 × 1·53 = 5·62 mins., or 5 mins. 37 secs. Next, suppose it is required to find the size of outlet to empty a tank 12 ft. × 8 ft. × 6 ft. in about 10 mins.: the tank area is 96 sq. ft., or 9·6 times our basis, therefore the corresponding time for the basis will be $\frac{10}{9{\cdot}6}$

= 1·04 min., and a reference to the table for 6 ft. depth shows the outlet must be between 5 in. and 6 in. dia.; a 5 in. outlet will empty the tank in 9·6 × 1·20 = 11½ mins., and a 6 in. one in 9·6 × 0·832 = 8 min.

A slightly different question is as to the time to run down a tank 10 ft. × 6 ft. from 5 ft. to 4 ft. depth, through a 4½ in. outlet? To empty 10 sq. ft. from 5 ft. requires 1·35 mins., and from 4 ft. requires 1·21 mins., so that to empty from 5 ft. to 4 ft. will require 1·35 — 1·21 = 0·14 mins., and multiplying by 6 for the tank area of 60 sq. ft. gives 0·84 min., or 50 secs., as the time required.

Finally, consider a large subsider, say 12 ft. × 8 ft. × 8 ft., wlth the first decanting cock 18 in. below the surface. The area is 9·6 times our basis, but 18 in. is not given in the table; however, we note that times vary with the sq. root of the depth, or the areas emptied in a given time vary inversely as that root, so that to empty 9·6 times our basis tank area through 18 in. is the same as to empty $9{\cdot}6 \sqrt{\frac{18}{24}} = 8{\cdot}3$ through 2 ft., and we readily find that the times for various sized decanting cocks will be as follow :—

Bore outlet.	Minutes.	Bore outlet.	Minutes.
5	5·7	3½	11.7
4½	7.1	3	15·9
4	9 0		

and the most suitable diameter of outlet can readily be settled. In general, an outlet should empty a tank (or a section of a tank) in not more than 10 mins., so that the decanting cock for the above subsider should not be less than 4 in. diameter, and either 4 in. or 4½ in. will usually be suitable.

It is interesting to note that to run-off the contents of a large water tank 20 ft. × 20 ft. × 10 ft. through a 6 in. bore outlet will take nearly three-quarters of an hour, though the first foot will run out in 1¼ mins.

TIME, IN MINUTES, TO EMPTY 10 SQ. FT. OF TANK AREA.

Bore of Outlet in Ins.	Initial Depth of Liquid in ft.									
	1	2	3	4	5	6	7	8	9	10
1	12·2	17·3	21·2	24·4	27·3	30·5	32·3	34·6	36·7	38·6
1½	5 43	7·68	9·41	10·9	12·1	13·3	14·4	15·4	16·3	17·2
2	3·06	4·32	5·29	6·11	6 83	7·63	8·08	8·64	9·17	9·66
2½	1·96	2·77	3·39	3·91	4·37	4·89	5·17	5·53	5·87	6·18
3	1·36	1·92	2·35	2·72	3·04	3·33	3·59	3·84	4·07	4·29
3½	0·998	1·41	1·73	2·00	2 23	2·44	2·64	2·82	2·99	3·16
4	0·764	1·08	1·32	1·53	1·71	1·87	2·02	2·16	2·29	2·41
4½	0 604	0·854	1·05	1·21	1·35	1·48	1·60	1·71	1·81	1·91
5	0·489	0·691	0·847	0·978	1·09	1·20	1·29	1·38	1·47	1·55
6	0·340	0·480	0·588	0·679	0·759	0·832	0·898	0·960	1·02	1·07
7	0 250	0·353	0·432	0·499	0·558	0·611	0·660	0·706	0·748	0·789
8	0·191	0·270	0·331	0·382	0·427	0·468	0·505	0·540	0·573	0·604

Good results have been reported on the use of paradichlorbenzene (known before the war as "Globol") as a soil fumigant for the prevention of cane grubs and other insect pests. In respect of material[1] and labour, the cost is said to be very slight. At Greenhills, Queensland, Mr. E. JARVIS, the Government Entomologist, treated the soil of a plot of Badila cane with ¼ oz. portions of the white crystalline compound, these portions being placed 7 in. deep, 1 ft. apart, and 4–6 in. from the stools. Actually the application was made by means of metal hand injections, devised by the experimenter, these burying the fumigant uniformly without the necessity of handling it.

[1] It is sold in refined or crude form by The Sugar Manufacturers' Supply Co., Ltd. of 2, St. Dunstan's Hill, London, E.C. 3.

Preliminary Investigation on the Pectic Substances of Plants.

By R. G. W. FARNELL,

Chemist, British Empire Sugar Research Association.

INTRODUCTION.

The work described in this paper[1] has been carried out in conjunction with Prof. SCHRYVER of the Biochemical Department, Imperial College of Science and Technology, South Kensington, who was of the opinion that the best method of gaining a knowledge of pectic substances was to assist in an investigation under his supervision already in process in his laboratory.

Since April 1922 (when the research was commenced), it has not been possible to investigate the pectic products of chief interest to the sugar industry, namely those of the cane and the beet, owing to supplies of these materials not being available. Instead, attention has been confined to the study of pectens derived from other plants. It is hoped shortly to study the soluble juice pecten of the cane in the West Indies; and in October, when the campaign opens at Kelham and Cantley, it will be possible for work to be carried out at South Kensington on beet pectic products.

HISTORICAL NOTES ON PECTENS.

FRÉMY[2] showed that soluble pectens were produced from an insoluble parent "pectose" during the ripening of fruits, and he distinguished between various individual pectic products obtained by treating soluble "pecten" and insoluble "pectose" with acids and alkalis, but there does not appear to be sufficient evidence for the basis of his conclusions.

The literature on the subjects of pectens is voluminous, though characterized by confusion and contradictory statements. It must be borne in mind that a great deal of the work was carried out more than 30 years ago before researches into the domain of colloidal chemistry had revealed that differences in solubility and state of aggregation need not necessarily imply differences in chemical composition and chemical identity.

It is now generally supposed that the class of substances known as the pectens comprise the middle lamellæ of all plant cells. During the maturing of plants and fruits, enzyme action renders soluble part of the pecten, which finds its way into the juice. We may thus distinguish two main classes of pectic substances: tissue pecten; and juice pecten. Since the first is the parent of the second, it may (as proposed by SCHRYVER), conveniently be called *pectinogen* (i.e., pecten-producing). As a knowledge of the tissue pecten is essential before a study can be made of the soluble juice pectin derived from it, we are here principally concerned with pectinogen.

PECTINOGEN, ITS EXTRACTION AND PROPERTIES.

Extraction of pectinogen.—Plant tissue pectinogen appears to be loosely combined with calcium, and treatment of the dried tissues with hot water extracts no pectic product. Schryver's method of extraction consists in treating the tissues (after elimination of all juices) with hot dilute ammonium oxalate solution; precipitating the dissolved pectinogen with an excess of alcohol; filtering; washing with alcohol; and drying *in vacuo*. Oxalic acid may be used instead of ammonium oxalate, and it has the great advantage that unlike its ammonium

[1] Here slightly abridged. [2] *Journ. Pharm.*, 26, 368. *Ann. Chim. Phys.*, 24, 5.

salt it is readily soluble in alcohol, and therefore does not contaminate the pectinogen gel on precipitation. When ammonium oxalate is used, this salt is precipitated with the gel, and the only method of completely eliminating it is by repeated dialysis. Small amounts of pectinogen can also be extracted by other salts yielding insoluble calcium compounds, as ammonium sulphate; while by treating plant tissues in hot water with carbon dioxide, and pouring the filtered extract into alcohol, a trace of pectinogen is obtained.

Properties of pectinogen.—When dry, pectinogen is practically white in colour, and of horny texture. It forms extremely viscous colloidal solutions in water; a solution more concentrated than 3 per cent. has not been obtained, but at this concentration the solution is of the consistency of syrup, and quite impossible to filter. A solution of pectinogen may be precipitated by pouring it into an excess of alcohol, as above stated; and coagulation may also be brought about by concentrated solutions of salts, the best of which are those of calcium and barium.

Dialysed pectinogen possesses a slightly acid reaction, and when 0·3 grm. is dissolved in alkali it neutralizes immediately about 1 c.c. of N/10 sodium hydroxide and a further 10 c.c. after standing for half an hour. The first action appears to be the neutralization of the residual acidity of the pectinogen; while in the second a change occurs resulting in the formation of the sodium salt of pectic acid with the liberation of methyl alcohol. On acidifying a solution of pectinogen which has stood in contact with alkali, a gel of pectic acid is precipitated.

Pectinogen so far has been found to contain pentose (araban), galactan and methoxyl groups. Repeated analysis fails to eliminate small amounts of inorganic substances revealed as "ash"; and one must suppose that they are bound up in the pectinogen complex. The enzyme *pectase* (contained in clover) has been shown by TUTIN[1] to bring about in pectinogen the same change as alkali, viz., the formation of pectic acid and subsequent gelation. Pectinogen is dextrorotatory, its $[\alpha]_D^{20}$ varying from $+ 250$ to $+ 330$.

Pectic acid.—This substance is formed (as stated) from pectinogen either by the action of alkalis or by the enzyme pectose. It differs from pectinogen in being insoluble, contains no methoxyl group, and appears to have a pectose content (39 to 42 per cent.) irrespective of its origin. Its specific rotation is fairly constant. It has been investigated by SCHRYVER and HAYNES,[2] and by SCHRYVER, NORRIS, and CLAYSON,[3] to which papers reference should be made for fuller information.

EXPERIMENTAL WORK ON PECTINOGEN.

Extraction of pectinogen.—The raw material was sliced, and pressed in a tincture press; the residues were washed with water, drained on muslin, and again pressed, the processes of alternate pressing and washing being repeated at least six times until the runnings from the press were practically colourless. Finally the residues were boiled in alcohol (to remove most of the pigment and essential oils), and dried in a current of air, being then ready for the extraction process.

This extraction process consisted in slowly adding 100 grms. to 2 litres of a 0·5 per cent. solution of either ammonium oxalate or oxalic acid, which was kept at 80–90°C. After continually stirring for half an hour, a viscous mass of porridge-like consistency was obtained, which was drained on muslin, and the residues pressed as thoroughly as possible. The residues were again treated in the same way as before with the ammonium oxalate or oxalic acid solution, and filtered

[1] *Biochem. J.*, 15, 424. [2] *Ibid.*, 10, 539. [3] *Ibid.*, 15, 643.

once more. These operations were repeated at least four times until the extract was practically clear. The pectinogen solution thus obtained (usually 6–8 litres) was partially clarified by passing through paper-pulp, poured into twice its volume of 95 per cent. alcohol, and the precipitated gel of pectinogen allowed to stand for at least 12 hours before filtering. After its separation, it was treated with alcohol graded from 70 to 100 per cent., and finally with ether. It had then become hard, and almost granular. It was dried in a current of air for 24 hours, and finally in a desiccator over phosphorus pentoxide where it remained *in vacuo* for a fortnight.

Turnip, onion, and pea-pod were examined in the manner described, and the yield of dry pectinogen from these three materials, using oxalic acid as the extraction solution, was 20, 16, and 8 per cent. With ammonium oxalate the yields were the same, provided the extract was dialysed; but with ammonium sulphate solution and with carbon dioxide much lower yields were obtained.

Analysis of pectinogen.—Ash was determined by incineration in a platinum crucible; ammonium oxalate by the Kjeldahl method; while for methoxyl both Zeisel's and Schryver and Wood's[1] processes were applied. Galactan was not always estimated, and where analysed Tollen's method of oxidation to mucic acid was used.

On analysing pectinogen obtained from different sources, it was found to differ according to the raw material from which it had been obtained. Thus in the case of turnip, onion and pea pod, the galactan found was: 40·9, 34·9 and 17·9; pentose, 37·6, 17·6 and 30·7, and methoxyl, 10·2, 3·2 and 1·9 per cent. Further, it was seen that the method of extraction employed has an influence on the composition of the pectinogen. In general ammonium oxalate extracts a pectinogen higher in pentose and lower in methoxyl than that obtained with oxalic acid.

When solutions of pectinogen were boiled in water (over a reflux condenser) for eight hours, the pentose constituent suffered only a very slight change, but the methoxyl diminished to the extent of about 30 per cent.

Estimation of Pectinogen and Pectic Acid.

The method employed is based on the conversion of pectinogen by caustic soda to pectic acid, which can be quantitatively precipitated in the presence of acetic acid by calcium chloride solution, the gel flocculated on boiling being filtered through a tared paper, washed free from calcium chloride, and dried. It seems probable (though not certain) that the gel formed is the calcium salt of pectic acid. This method is extremely accurate, and detects the presence of pectic substances in far smaller concentration than that necessary to give a precipitate in alcohol (which is the method generally employed in sugar laboratories for the determination of the "gums and pectens"). As the quantity of the pectic acid varies according to the course of the pectinogen, it is necessary to determine the ratio $\frac{\text{pectic acid}}{\text{pectinogen}}$ for the different products. In the case of pectinogen of turnip origin, the ratio $\frac{\text{calcium precipitate}}{\text{pectinogen}}$ was found to be 0·817.

Actual details of the procedure are as follows:—Pectinogen solution containing not more than 0·05 grm. of the colloid is treated with about 30 c.c. of distilled water; 100 c.c. of N/10 sodium hydroxide solution is added, and the mixture left over-night to allow of complete conversion to pectic acid. Then 50 c.c. of N/1 acetic acid are added, followed by 50 c.c. of a solution of calcium

[1] *Analyst*, 1920, 45, 164.

chloride of molar strength (111 grms. per litre), and the whole boiled for 10 mins It is filtered hot through a small fluted filter paper (Whatman No. 1, 11 cm.), which has been tared after drying at 100°C. Subsequent washing is an easy matter, and this is continued till the washings are chloride-free, the tared paper being finally dried at 100°C. to constant weight.

Absorption of Pectinogen by Decolorizing Carbon ("Norit").

Some experiments carried out with an 0·1 per cent. solution of pectinogen, using varying amounts of "Norit," showed that with an amount of the decolorizing carbon less than the weight of pecten the percentage absorbed is insignificant. To obtain a greater absorption of the pecten,[1] more of the decolorizing carbon must be used.

In Java it has been shown that the amount of "gums and pectens"[2] removed in different processes of clarification is as follows: defecation, 46; single carbonatation, 70, sulphitation followed by $\frac{1}{2}$ per cent. of "Norit," 19; and sulphitation followed by 1 per cent. of "Norit," 66 per cent.

But any such comparison of the efficiency of different clarification processes in removing pecten is of little use until a more extensive knowledge is gained of the precise nature of the substances classified under "gums and pectens."

Proposed Lines of Research.

A series of experiments should be undertaken to compare the pectinogen in the fibre of the cane with the soluble pectens contained in the juice at different stages of maturity. A study should be made of the ratio $\frac{\text{sucrose}}{\text{pecten}}$ in the juice, syrup, and molasses, and the influence of pectic substances on viscosity. Experiments should be made on the extraction of pectinogen from beet, and its properties examined. And an investigation on the precipitation of pectin both in the presence and the absence of sucrose, reducing sugars, etc., by the various methods of clarification in practice might yield results of interest.

The Honduras Sugar Industry.

Department of Overseas Trade Report.

Owing to adverse conditions in the world's consuming markets, the production of sugar in Honduras has not yet assumed very large proportions, though arrangements have been made—in an extension of the cane area under cultivation and the construction of adequate plant—on the return of favourable conditions, for the exploitation of this industry on an elaborate scale. One company (The Honduras Sugar & Distilling Company, at Monte Cristo, near La Ceiba) has a milling capacity of 750 tons of cane daily, but this enterprise has been surpassed in size and importance by a factory, inaugurated on July 4th, 1922, built at La Lima, near San Pedro Sula (by the Compagnie Agricola Sula), which has a daily milling capacity of 1500 tons of cane. This latter plant, when in full working order, will, it is believed, be the largest of its kind in Central America. The most recent official statistics of sugar exports from Honduras are as follows:—

	Lbs.	Dols. (U.S. Gold).
1918-19	15,646,200	1,021,416
1919-20	11,242,583	1,156,532
1920-21	12,286,670	792,182

[1] "Pecten" here refers to the constituent of pectenogen which calcium chloride precipitates.
[2] That is, "Gums and pectens" as determined by precipitation in alcohol.

New Haven Meeting of the Sugar Section of the American Chemical Society.

The Spring meeting of the American Chemical Society was held at New Haven, Conn., from April 3rd to the 7th inclusive, and a number of interesting papers were read and discussed before the Division of Sugar Chemistry. Short abstracts of a few of these are now given below.

Simplification of various routine tests for beet factories. By *K. R. Lindfors.*—Neutral or slightly acidified lead acetate is used to decompose saccharate in lime cake and Steffen's waste and wash waters. It can also be utilized to complete the decomposition of saccharate cake and "cooler" solutions. Walker's method[1] is adapted for the determination of raffinose and sucrose. Add 1 c.c. of HCl solution (60 acid to 40 water), heat to 70°C., remove from waterbath, add 10 c.c. of HCl (strength as before) and leave the flask to stand in the air for 45 minutes. Cool, fill up to mark, filter, add a little zinc dust to filtrate, stir, filter again, and polarize as usual. The Brown-Duval moisture tester for grain is well adapted for determination of moisture in dried pulp. With pulp, 50 grms. of material is weighed out, transferred to distilling flask, 250 c.c. of oil added, and mixture heated to 190°C. The same apparatus can also be used for the determination of water in molasses, massecuite and brown sugar. Gums in diffusion juice are determined by the centrifugal method, using potash flasks as follows: To 5 c.c. of the diffusion juice add ½ c.c. of conc. HCl and 15 c.c. of alcohol; keep mixture at about 70°C. for about 15 minutes; one degree on stem corresponds to 0·04 per cent. gums. Borax is used for standardizing normal solutions. As indicator, dimethyl-amido-azobenzene is recommended in place of methyl orange.

The determination of ash in Cuban raw sugar. By *U. S. Jamison and J. R. Withrow.*—The authors have been accustomed to determine ash in sugar and syrups by the usual method of direct incineration. Nevertheless, others use the process more commonly mentioned in the literature, namely, the sulphate method. This investigation was conducted to make a careful comparison between the results obtained on the same samples by various procedures, particularly the sulphate method. The authors still prefer the direct incineration method as simpler and more rapid than the sulphate, but suggest a modification of the usual sulphate method, using dilute sulphuric acid with which to moisten the sugar rather than water, this giving results more rapidly than the ordinary sulphate method. Various modifications of the direct incineration method were tried. The benzoic acid modification was rapid, but the ash was fluffy and easily lost. The vaseline oil modification prevents foaming over, but ammonium carbonate causes loss by spattering. Sand reduces foam, but gives low results. Zinc oxide gives results intermediate between direct incineration and sulphating. Lixiviation shows no advantage over direct incineration. Direct incineration offered no difficulty in weighing. The usual reduction factor on sulphated ash of 10 per cent. as stated in the literature gives results on Cuban sugars which are still 34 per cent. higher than the ash by direct loss. No loss in weight of ash was experienced upon ignition, as was mentioned by LANDOLT.

Precise determination of ash in sugars. By *Y. L. Pun and J. R. Withrow.*—A critical study of the existing methods of ash determination was made, particular attention being paid to the different temperatures and various kinds and shapes of dishes. Results show that 500° C. is the favourable temperature to be used for the direct methods. The sulphate method gives practically constant

[1] *I.S.J.*, 1918, 239.

values from 400° to 700° C.; and 0·65 is found to be the suitable factor for converting the sulphated ash to carbonated ash at 500°C. for most samples of raw sugar. Silica dishes give low results. Porcelain crucibles of various sizes serve just as well as platinum dishes. The authors point out the disadvantages and advantages of various modified sulphated and direct methods, and propose to use the simple direct method at 500°C. without using any admixtures. Details of the manipulation of the proposed method were given. Other food products were also used to test the proposed direct method.

Adsorption of colour from sugar solutions by chars. By *F. Bonnet, Jr.*—The removal of colour from sugar solutions by chars of one kind or another has been shown by quite a number of investigators to be a case of adsorption, which is represented by the Freundlich equation: $\frac{X}{M} = KC^{\frac{1}{n}}$; in which X = grms. of solute adsorbed: M = grms. of adsorbent; and C = concentration of solute in equilibrium with adsorbent. *K* and *N* are constants which vary, depending upon conditions under which the adsorption takes place. Chars are not equally effective in removing colour, even from similar solutions; and a proper evaluation is only possible if the above equation is intelligently made use of. Charts illustrating the above were shown and discussed.

Bacteria and their relation to the sugars. By *A. I. Kendall.*—A relationship exists between the protoplasmic asymmetry of certain bacteria and their respective abilities to utilize carbohydrate of definite stereo-configuration for energy. One indication of this utilization is an increase in the hydrogen ion concentration of the medium in which the reaction takes place. One/100,000 of a grm. of sugar in 1 c.c. of solution frequently induces a detectable change in hydrogen ion concentration in properly controlled experiments. A library of bacteria of predetermined carbohydrate fermenting powers may be utilized to identify carbohydrates in unknown solutions, to detect certain impurities in carbohydrate solutions, and to estimate the amounts of carbohydrate in solutions.

Formation of maltose in sweet potatoes on cooking. By *H. C. Gore.*—Maltose is shown to be formed in quantity in sweet potatoes upon cooking. This is evidenced by the agreement of the amounts of sugars formed as determined by copper reduction with the quantities found by polarization, and also by the isolation of crystalline maltose in quantity. It is further shown that maltose formation does not occur at the boiling point but only at the temperature at which diastase is active. As certain standard varieties of sweet potatoes (Porto Rico and Nancy Hall) are known to be at least as rich in diastase as green barley malt, the evidence on the whole is that the formation of maltose is due to diastase. Sugar formation was found to occur with great rapidity during the initial stages of the digestive action, thus showing the close association of starch with the diastase in the cells of the sweet potato.

Very finely divided sulphur has long been used for combating mould diseases of plants, mildew on roses, for example; but recently colloidal sulphur has been recommended [1] as being more effective. A certain firm in Germany has now put on the market a preparation consisting of colloidal sulphur in water, this liquid being diluted and sprayed on the plant affected. At the Experiment Station, Java, some preliminary experiments on the value of such colloidal sulphur solutions for dealing with insect diseases have been carried out,[2] and, it is stated with good results. A dilution of 1–2 per cent. was used, and the plants showed no sign of damage owing to "burning," as is often noticed in the case of ordinary sulphur wash.

[1] *Chemiker Zeitung*, 1921, 497. [2] *Archief*, 1923, **30**, No. 36, 671, 99.

Cutting, Loading, and General Transportation in Hawaii.[1]

By JOHN M. ROSS.

Cane Cutting.—As far as cutting our cane is concerned, we are (in Hawaii) still solely dependent on the cane knife and the man wielding it. From advertising matter, it is stated that considerable progress is being made in Cuba with the Luce cane cutting machine. We can readily understand that such a machine operating on one-year-crop canes would not have the difficulties to contend with that it would with our two-year-crop system.

Our Committee has learned nothing further of the cutting machine invented by SIR PERCY SCOTT[2] other than that reported on last year. As to its success or failure, it can only be conjectured that it has not been widely or extensively used, or this fact would have come to our attention through press notices.

Another cane cutting appliance that has been patented is what is known as the Patten Meeker and Toledo cane cutting and topping machine. Its design and blue prints have been examined by several members of this Committee and that on Labour Saving Devices. So far no adverse criticism of this design of machine has been heard by us. Several plantation members have expressed themselves as being favourable to contributing towards the expense of a trial machine. The motor power intended to be used is a 20-25 h.p. Yuba Tractor. It is estimated that a trial machine could be built for about $16,000. It would appear from the designs of this machine that if it will cut and top cane as anticipated, it can be equipped for loading cane also, all in one operation. So far the only practical help in cutting cane is burning ahead of the cutters.

Loading and Transporting.—In the North and South Hilo districts (Kaiwiki Sugar Company excepted) fluming is the sole system of transportation and is unquestionably the most satisfactory and economical system in Hawaii to-day.

Hamakua district practises all three systems: Wire rope into railroad cars; thence by gravity railroad; flumes into railroad cars; wagons into gravity and railroad cars; and also wire rope direct to the cane carriers.

Kohala district practises two systems: flumes to cane carriers, wagons loaded in the field and hauled out to collecting stations where wagon trains are made up and hauled to the mill by caterpillar tractor; and tractor engines.

Kau has its flume system to cane carrier direct and into railroad cars. Kona has wire cable into railroad cars.

On lands below the contour of their lowest flumes, the Onomea Sugar Company have used large gooseneck drays with much success. The body is low down, not above 24 ins. above the ground, and carries about three tons of cane to a load hauled by Holt tractors. Two tractors will keep three of such drays busy. Wire rope and light portable track are used in all this district for taking cane up out of steep gulch sides where it is impracticable to lay flumes.

The writer believes it is false economy to economize on main or stationary flumes. Portable flumes are costly in the amount spent in labour on constant re-erection, which would go far towards the interest on the investment of the stationary flume while lying idle. In addition, 50 per cent. of the time lost at the mills through flume jams is directly traceable to the portable flume, no matter whether that jam takes place in the main flume or not.

[1] Report, dated September 9th, 1922, presented to the Hawaiian Sugar Planters' Association, here slightly abridged.

[2] *I.S.J.*, 1922, 440.

Cutting, Loading, and General Transportation in Hawaii.

The Hakalau plantation is steadily increasing the number and length of their main flume systems, but there is still lots of room for extensions. Hakalau erected about two years ago 300 ft. of Armco iron flume, which makes an ideal cane flume and is positively water-tight at the end of two years. I consider the friction 25 per cent. less in this flume than in those made of wood, and as soon as the cane strikes the iron flume, the velocity of travel visibly increases. The only objection is its cost. Erection could possibly be materially reduced, as no doubt with experience in erection, many short cuts could be made. But to compete with wood flumes, the life of metal ones would have to be about 16 to 18 years. Whether they will last this length of time, remains to be seen; but where flume water is a serious factor, the cost should not be considered, as I feel sure it would repay itself in water conserved.

In general transportation, auto trucks are steadily increasing in numbers on the various plantations, both for the transportation of material as also that of the labourers to and from the fields.

Tractors are fast supplanting mules for all heavy ploughing. Many of the plantations have now definitely decided on the particular build of truck or motor best suited to their individual requirements, and are now standardizing on that special make. This to obviate the keeping on hand of spares for different models, thus making truck parts interchangeable so far as possible, and also motor parts.

Mr. F. M. ANDERSON, of Hakalau, has contributed the following information to the Committee:—

I have nothing new to report upon regarding cutting, which means that no machinery has been employed in cutting our cane, nor anywhere else in the island that I know of. It appears, however, that the Luce Cane Harvester has now been perfected to a degree which allows it to be used advantageously where the land is level and the rows prepared for such a machine.

Loading or packing, whether to flumes, wagons or cars, is still mostly done by manual labour. The problem of getting machines to do the work of loading on to cars seems to be less than the conditions for flumes or wagons. In loading on to cars, the continuous elevator type of apparatus has many advantages because almost any class of labour can perform such work, but some changes would be required in the construction of the rolling stock in order to handle a sufficient quantity of cane, either deeper framework on the present cars or additional cars. Considering the requirements of loading on to wagons, and the small quantity of cane that is handled this way, expensive and heavy equipment would be necessary, which would have to traverse the entire field to pick up the cane, and consequently the cost would run extremely high. For packing to the flume there does not seem to be very much trouble in getting this work done by manual labour, and in considering labour-saving devices for this class of work, the uneven and very often wet condition of the fields is the principal means of excluding machinery for this work where flumes are used.

Railroads, portable track, flumes, trucks and wagons are all used more or less extensively in general plantation transportation. Trucks are being used more and more in taking men to and from the fields. Tractors with a 50-ft. rope accomplish very satisfactory work with portable track conditions without having to straddle the track. Tractors are also very serviceable in handling empty or loaded cars on down-grades where car brakes are insufficient.

Lastly, Mr. A. W. COLLINS, Manager of the Pioneer Mill Co., Ltd., offers a detailed cost statement of the locomotives under his control for the first six months of the year, as follows:—

COST OF TRANSPORTATION BY RAIL DURING 1922.

PER TON-MILE FOR SIX MONTHS.

	Lahaina. Ton-miles.	Lahaina. Cost.	Kaanapali. Ton-miles.	Kaanapali. Cost.	Wahikuli. Ton-miles.	Wahikuli. Cost.	Kahana. Ton-miles.	Kahana. Cost.
Weight of engine	9 tons		11 tons		11½ tons		33¾ tons	
January ..	18,985·35 ..	609·45 ..	34,095·90 ..	799·08 ..	— ..	— ..	136,776·89 ..	951·90
February..	10,299 55 ..	507 34 ..	25,117·76 ..	728·99 ..	1,494·90 ..	73·55 ..	174,473·63 ..	995·34
March	14,232·83 ..	544 56 ..	12,923 05 ..	468·36 ..	54,019·37 ..	773·86 ..	182,164·58 ..	883·75
April	15,427·87 ..	599·24 ..	26,450·89 ..	703·56 ..	78,576·41 ..	1,116·59 ..	142,659·75 ..	973·98
May	21,730·65 ..	493 57 ..	33,760 02 ..	587·46 ..	120,229 35 ..	1,428·31 ..	107,920·61 ..	1,140·15
June	20,338·77 ..	693·94 ..	35,874·47 ..	703·30 ..	103,472·22 ..	1,346·88 ..	157,040·64 ..	1,034·41
Total..	101,015·02 ..	3,448·10 ..	168,222 09 ..	3,990·75 ..	357,747 34 ..	4,739·19 ..	901,036·10 ..	5,979 53
Average cost in dollars per ton-mile ..	0·0341		0·0237		0 0132		0·00663	

European Sugar Beet Sowings for 1923.

Licht's Preliminary Forecast.

The following first estimate of the European sugar beet sowings for 1923 has been issued by F. O. LICHT. We give last year's figures for comparison; from these it will be seen that there is an increase this year of about 18 per cent.

	1922. Hectares.		1923. Hectares.
Germany	360,441	....	337,000
Czecho-Slovakia..	182,849	....	235,000
France	116,410	....	145,000
Holland	57,526	..	72,500
Belgium	59,176	....	66,500
Sweden..	16,716	....	32,000
Denmark	24,330	....	30,000
Poland	107,825	....	150,000
Russia	175,000	....	230,000
Hungary	28,775	....	35,000
Italy..	85,000	....	90,000
Others	113,402	....	145,000
	1,327,450	....	1,568,000

Estimation of the 1923 Java Cane Sugar Crop.

Messrs. GYSELMAN & STEUP, of Sourabaya, have compiled the estimates of the individual Java sugar factories for the season just begun. Expressed in piculs of 136 lbs. they are as follows:—

	Piculs.
Superior first sugars	15,278,569
Superior soft sugar	376,181
Head sugar—Dutch standard 16 and higher.. ..	6,182,802
Head sugar—Dutch standard 12/14	6,342,600
Molasses sugar	468,042
Centrifugalled bag sugar	28,070
Common bag sugar	12,770
Total crop	26,690,034 piculs,

equivalent to 1,742,000 tons of 2240 lbs.

"Sum-azine" Blue for the Improvement of the Colour of White Sugars.

Ultramarine blue has long been used for the neutralization of the yellowish tinge of off-colour sugar, a good white tone thus being produced, and the appearance of the crystals greatly improved. But this pigment possesses the serious limitation that in contact with acids it liberates the bad-smelling gas, sulphuretted hydrogen, H_2S. Hence, sugars which have been treated with it can hardly be used for the manufacture of preserves, for the sweetening of lemonade and other soft drinks, or indeed for addition to any liquid containing even a slight trace of acid.

Advantages of "Sum-azine."

A blue preparation, known as "Sum-azine," which obviates this great disadvantage, and which in every way is suitable for the tinting of yellowish sugars, has now been put on the market, and is expected to meet a requirement that has been felt for some time. It is quite unaffected by acids and alkalis; it is not influenced by exposure to light; it is harmless to the human system; it has a very high tinctorial power; and it is readily miscible with water, apparently forming a colloidal solution, from which, however, the colour does not separate even after long standing. Especially, its colour (or rather its mixture of colours) neutralizes, not only the yellowish shade, but also masks the greyish tinge which plantation white sugars generally possess to a greater or less extent. This is an important advantage, which, combined with the several qualities enumerated above, should give this new preparation preference over ultramarine blue and the substitutes that have from time to time been proposed.

Method of using "Sum-azine."

"Sum-azine" is sold in the form of a powder; and probably the most practical method of applying it in the refinery or white sugar factory is as follows: Four to six ounces (114 to 171 grms.) are dissolved in about 45 gallons (205 litres) of water contained in a cask or tank, placed on the floor or stage above the centrifugal machines. This cask or tank is provided with a small out-let pipe leading down to the level of the centrifugal machines, and at the end of the pipe a small tap is fixed. A can having a spray spout is filled from the tap with the blue water, which is applied to the sugar at the moment of "breaking," that is, just before the machine comes to rest. Centrifugal operators should be instructed not to make the addition when the machine is in a fairly rapid state of revolution, otherwise most of the blue water will be swung out and its effect thus lost. A few experiments will establish the right volume of the blue water to be applied by means of the can; and, even in the case of distinctly off-colour plantation whites, the amount of this intense blue preparation necessary per ton of finished sugar will be found to be exceedingly small, probably less than 1 oz. (28 grms.).

Sale of "Sum-azine."

"Sum-azine" is manufactured and sold by: The Sugar Manufacturers' Supply Co., Ltd., of 2, St. Dunstan's Hill, London, E.C. 3, England. It is put up in 7 lb. lever-top tins, which are packed in strong over-cases, suitable for export; also in specially made 1 cwt. barrels. Delivery can generally be given from stock. A sample sufficient for the treatment of about one ton of sugar will be forwarded free of cost on application.

Refiners and white sugar manufacturers are invited to make a trial with this special preparation, which is both stronger and cheaper than certain German preparations. They will find that its use will greatly improve the appearance of off-colour sugars, and thus distinctly enhance the market value of these products. The cost of the application of this blue preparation per ton of sugar will be found an almost inappreciable item.

American Commerce Reports.[1]

Conditions in European Sugar Industry.

The latest provisional estimate by F. O. Licht, the German sugar statistician, puts the European beet sugar crop of 1922-23 at 4,596,000 tons, a reduction of over 100,000 tons from his previous estimate.

Per capita consumption has increased in all the western European countries with the exception of Great Britain, where the use of sugar is curtailed through the high import duty imposed as a revenue measure during the war; but British consumption in 1922 exceeded that of the previous year by nearly 200,000 tons. The hoped-for reduction in the import duty would greatly stimulate British consumption. A protective tariff with correspondingly high price levels checks French consumption also. Consumption is steadily rising in Poland and Czechoslovakia. The 4,000,000 increase in Italy's population in the last decade, together with the augmented per capita consumption, has greatly expanded the country's sugar needs.

The beet farmers of France and Belgium, profiting through protection, have done well, and a substantial increase in acreage is indicated for the coming spring in both countries, though a farm-labour shortage must be reckoned with in the case of France. Prospects are not bright for increased sowings in Czechoslovakia, owing to unsettled labour conditions and the unsatisfactory prices of the last beet crop. Under the present system of control the German beet growers are discouraged because they must wait upwards of a year for final beet payments, and the prices fixed for sugar uniformly range below the world's market level.—[*European Trade Report, February, 1923.*]

The German Beet Sugar Industry.

Owing to the shortage of sugar in Germany and the failure of the various interests to come to an agreement, the Government has again been obliged to institute an economic control of the industry for the season of 1922-23, and for the execution of the economic control an organization known as the Sugar Control Board (Zuckerwirtschaftsstelle) has been created. All of the raw sugar factories and refineries in the country are subject to the board's regulations, which have been drawn up in the form of an agreement.

Distribution under Sugar Control Board.—The agreement provides that the board may require the raw sugar producers to place their entire output at the disposal of the sugar refineries. The board may also regulate the distribution of the refined sugar or may delegate this privilege to the Association of German Sugar Factories (Verein Deutscher Zucker Fabriken). For the purposes of distribution the board will place at the disposal of the various authorities of the German States sufficient quantities of sugar to supply the population of their respective districts with a per capita monthly allowance of 1 kilo of sugar. The State authorities may create subsidiary depots within their districts to facilitate the distribution, but must report to the board the number of such depots and the amounts of sugar given out by each. The State authorities and their subsidiaries are also empowered by the board to set the price of the sugar distributed by them, and this price is to be considered as a maximum price in the sense of the maximum price law.

The supply of refined sugar to be delivered to the sugar-using industries is also regulated by the board. Up to January 1st the chocolate, candy, and distilled liquor manufacturers were not permitted to use inland sugar, but it was available to all other sugar-consuming industries. Since January 1st, inland sugar is again permitted to be used by the chocolate and candy manuufacturers, and the manufacture of liqueurs is at present the only purpose for which its use is prohibited.

Function of Advisory Council.—The Sugar Control Board may have as many as 30 members, made up of representatives of the raw sugar factories and refineries in proportion to the total number of each. In case the board is unable to come to a decision on any

[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

question under consideration, the Minister of Food and Agriculture decides the matter. All fundamental questions pertaining to the distribution of refined sugar, the changing or fixing of prices, and the issuances of instructions are to be heard by an advisory council consisting of 28 members. The activities of the advisory council are directed by a representative of the Ministry of Food and Agriculture, while the chairman and secretary of the Sugar Control Board have a participating voice in the deliberation of the advisory council.

The advisory council is called by the Federal Sugar Commissary representing the Ministry of Food and Agriculture, who must convene it when such questions as those mentioned above arise, or when either the Sugar Control Board, or one-third of the advisory council demand it.

Through the loss of territory in East and West Prussia, by which Poland gained 26 raw sugar factories, the burden of supplying most of the raw sugar of the country has been thrown on central Germany, thus bringing about a concentrative movement among the raw sugar interests of that section. Recently 33 raw sugar factories were incorporated into the Union of Central German Raw Sugar Factories. The stockholders of this union, who are for the most part sugar beet growers, in order to insure an outlet for their raw sugar absorbed the Halle sugar refinery into the union. This combination endangered the raw material supply of the Rositz refinery, one of the largest in Germany, and as a result it has also come into the union. The refining of sugar in central Germany is therefore entirely in the hands of the union, which has attained a position of such power in the market as to be able to influence the supply of raw material and the prices of the refined products.

Regulations governing imports and exports of sugar.—Imported sugar and its products are not subject to price control in any way. The amount of sugar imported, however, is controlled and is limited to the industries requiring it for further manufacture. Such industries must demonstrate the necessity for importation before an import license is issued. The export of sugar is limited to the proportionate amount of sugar imported. There is practically no general exportation of raw sugar, and only those concerns which import sugar for further preparation may export an amount equal to their imports.

The Government sets a minimum export price on sugar, which is in accord with the world market and which requires that exports be paid for in the currency of the country of destination, provided that currency is at a higher value than the currency of Germany. If sugar is imported and is not re-exported in a more highly refined form within two months of the time of importation, it must be put on the German market whether it has been worked or not.

According to the chairman of the Verein Deutscher Zucker Fabriken, the Government does not subsidize the industry in any way. He stated, however, that most of the factories and refineries have been modernized and that with sufficient raw material they are capable of producing twice as much as they do at the present time.

There is in Germany at present but one factory of importance which recovers sugar from waste molasses. This is a plant at Dessau, which employs the strontium process. The Steffens process is still being used by a few small and unimportant concerns.—[*Berlin Trade Commissioner's Report, January, 1923*.]

THE BULGARIAN SUGAR INDUSTRY.

Bulgaria has five large, well-equipped beet sugar factories, with a potential producing capacity of 50,000 metric tons of refined sugar annually. The annual pre-war sugar consumption in Bulgaria ranged around 35,000 tons, but has now declined to some 25,000 tons. A tendency to increased consumption may be anticipated in view of the fact that thousands of refugees have migrated into the country from Macedonia and eastern Thrace. Despite a loss of 8·5 per cent. in territory, the population has increased by about 500,000 over pre-war figures. Were the factories operating at full capacity, the country would already be on an exporting basis. This, however, is not the case. During the calendar year 1921, Bulgaria imported some 2500 tons of refined sugar. No official figures are yet available

for the calendar year 1922, but it is the opinion of the trade that imports during the current campaign will be heavier than heretofore. The director of a large sugar factory at Sofia stated that his plant will not run at more than 20 per cent. capacity this season. The beets cannot be obtained. Farmers are holding out for higher prices for the raw beets and display a tendency to turn from beet raising to the culture of more remunerative crops, such as tobacco.

Sugar producers are of the opinion that Bulgarian domestic production during the present campaign will amount to some 15,000 tons of refined sugar, leaving 10,000 tons to be purchased abroad.

The opinion is expressed in trade circles that, could the farmers be persuaded to plant a sufficient quantity of beets, national consumption could be covered in the space of one season. The agrarian policy of the Bulgarian Government, however, favours the farmer and encourages him in demanding higher prices for his produce. It is not probable, therefore, that Bulgaria will figure in the world's sugar market on the export side for many years to come. In fact, there is every reason to believe that the country will remain for some years in the position of a customer.

The situation may be summed up by stating that although from the manufacturing standpoint the country is sufficiently equipped for covering all domestic needs, the farmers have displayed little interest in growing beets at the current prices. The future of the industry, therefore, depends largely upon the world price of sugar and the ability of refiners to offer better terms to the growers.—[*Dept. of Commerce Report, January, 1923.*]

SUGAR INDUSTRY IN BRITISH AND DUTCH GUIANA.

The average acreage under sugar cultivation in British Guiana from 1914 to 1918, inclusive, was 76,672 acres. In 1919 there were 73,565 acres planted to sugar, 69,582 acres in 1920, and 65,420 acres in 1921.

The production of sugar in British and Dutch Guiana from 1912 to 1921 is shown in the following table. The estimated production of sugar in British Guiana for 1922 is also given.

YEAR.	BRITISH GUIANA. *Long Tons.*	DUTCH GUIANA. *Long Tons*	YEAR	BRITISH GUIANA. *Long Tons.*	DUTCH GUIANA. *Long Tons.*
1912	86,410	9,789	1918	107,560	12,280
1913	106,211	13,457	1919	86,971	7,702
1914	116,622	15,263	1920	*90,000	10,253
1915	119,091	14,984	1921	*115,000	11,309
1916	114,292	13,241	1922	*100,000	(†)
1917	108,181	14,590			

The plantations in British Guiana are staffed for the most part by Europeans. African labour is employed for the mechanical work, as well as for the performance of the heavier tasks in the sugar fields. The majority of all plantation labour is East Indian. According to the census of 1921, out of a total population of all ages on the sugar estates in British Guiana, which was 66,517 persons, 52,090 were East Indians. The total East Indian population of all ages in the entire colony in 1921 was 124,938 persons.

The exports of sugar from British Guiana in 1922 amounted to 90,571 tons as compared with 108,270 tons for 1921. Practically all of this sugar went to the United Kingdom and to British possessions, in both years, but the increased proportion sent to Canada in 1922, as shown by the following figures is noteworthy: To the United Kingdom, 27,439 tons in 1922 and 52,975 tons in 1921; to Canada, 62,938 tons in 1922 and 54,699 tons in 1921.

SUGAR INDUSTRY IN TUCUMAN PROVINCE, ARGENTINA.

The replacement of the native sugar cane by the hardier Java variety in the Province of Tucuman, Argentina, was almost complete in November, 1922, and it may be stated without exaggeration that the change saved the industry in this province from perishing.

* Estimated. † Data not available.

According to returns issued by the Tucuman Province Government, the change was introduced after the disastrous failure of the harvest in 1917, when the complete degeneration of the native cane became evident.

The statistics in the following table show the sugar production in the Tucuman Province during 1915 to 1922, with the amount of cane crushed for four of these years. The number of factories operating is given only for the years 1915 to 1917, and for 1919.

Years	Factories. Number	Cane crushed. Metric tons	Sugar produced. Metric tons
1915	26	1,797,631	104,045
1916	21	883,435	44,583
1917	19	—	44,465
1918	—	1,650,226	86,877
1919	27	—	448,137
1920	—	—	165,130
1921	—	—	163,040
1922	—	2,471,515	172,529

At the end of October, 1922, 137,562 tons of sugar and its by-products had been marketed. The quantity of refined sugar on hand was only 15,385 tons and of unrefined 19,003 tons.

JAVA SUGAR PRODUCTION.

The total production of Java sugar for the years 1916 to 1922, together with the yield of sugar per acre, as compiled by the Experimental Station at Passoeroean, Java, is shown to be as follows:—

Year.	Piculs	Long Tons.	Pounds. Per Acre.
1916	26,389,173	1,630,000	9,224
1917	29,502,636	1,822,000	10,118
1918	28,791,645	1,778,000	9,715
1919	21,633,525	1,336,000	8,648
1920	24,998,263	1,544,000	8,813
1921	27,285,575	1,685,000	9,411
*1922	29,172,006	1,802,000	9,964

During the past few years, much useful research has been done on the use of certain dyes for the destruction of protozoa and bacteria, and so far has this work progressed that at Manchester, Worcester, Bury, Tunstall and other towns in England blue dyes are used in sewage purification for killing the protozoa, the bacteria present not being affected at the particular concentration used, so that in this way a constant number of these organisms can be maintained in operation. In a lecture recently delivered before the Royal Society of Arts, T. H. FAIRBROTHER and ARNOLD RENSHAW [1] gave an account of their investigations regarding the activity of a wide range of dyes. In the case of Meldola Blue D, and the paramoecia (isolated from sewage), immediate death occurred in a dilution of 1 in 80,000 and in 2½ hours in one of 1 in 160,000. This is surely a noteworthy result, since Neo Salvarsan solution in a dilution of 1 in 200 failed to kill the same organisms within two hours.

Sodium hypochlorite has long been employed as a wound antiseptic (as Eau de Javelle and Labarraque's solution), but its caustic action and inconstant composition have been disadvantages preventing its extended use as a germicide. During the war, Dr. DAKIN did much valuable work on the use of the chloramines, which form powerful antiseptics, and in aqueous solution do not irritate and are constant in composition, the activity being dependent on the NCl grouping. Now, the same investigator has shown that para-sulphon-dichloramino-benzoic acid, which likewise contains the chloramine grouping, is highly efficient as a water sterilizer. At a concentration of 1 in 300,000 it destroys the organisms of cholera, typhoid, coli, and dysentery, in about 30 min., even in highly contaminated water. This is therefore a germicide of great interest in the tropics. It can be bought in tablets containing 0·004 grm., sufficient for the sterilization of one quart of water, and even in large doses it is non-toxic, whereas certain physiological effects are generally attached to the use of similar reagents.

* Estimated.

[1] *Journal of the Royal Society of Arts*, 1923, 71, No. 3669, 302 *et seq.*

Publications Received.

Betriebskontrolle der Zuckerfabrikation. I Teil: Laboratoriums und Betriebskontrolle in Rohzuckerfabriken und Raffinerien. First Edition. By Dr. Oskar Wohryzek. II Teil: Chemisch-Technische Rechnungen. By Dr. Oskar Wohryzek. Second Edition. (Albert Rathke, Magdeburg, Germany). 1923.

Dr. WOHRYZEK, of the Zuckerfabrik Dioseg, Slovakia, author of that valuable work, "Chemie der Zuckerindustrie," is editing a series of five books on the running of a beet sugar factory, and these when completed will cover: (*1*) methods of sampling and analysis, and the organization of laboratory work; (*2*) calculation of the analytical results obtained, and other computations in factory chemical control; (*3*) calculations relating to steam; (*4*) machinery work; and (*5*) the commercial management of the beet factory. So far only the first two numbers of the "ring" have appeared, and Dr. WOHRYZEK is the author of both. Regarding the first, this describes methods of sampling and analysing the various products from roots to molasses, and also some of the chemicals and materials which are used in the production of raw sugar and its refining. In compiling this book, Dr. WOHRYZEK has (we understand) sought the advice and criticism of his colleagues; and it is evident throughout that the processes have been selected and described with especial care, the object in view evidently being the publication of a book that shall be recognized by specialists of the industry as a standard compilation, and the textbook for carrying out "mutual control." It is indeed a very satisfactory compilation, which bears on every page evidence of its author's considerable experience and great thoroughness. Apart from the mere methods of sampling and analysis, there are several chapters having a useful bearing on the interpretation of the main subject matter, these treating of the cause of sugar losses, and the prevention of them; of boiler-house control; of the organization of the laboratory; of the apparatus used by the chemist, and its manipulation; and of rapidity and accuracy in analysis. Then this book is concluded by a chapter entitled "Super-kontrolle für Zuckerfabriken." In a large number of Continental beet factories, if indeed not in most, it would appear that the work of the laboratory leaves much to be desired. In fact it is explained that the results do not command the respect and attention to which they might otherwise be entitled. Sampling is often false; analyses are performed in a faulty way, and indeed sometimes do not seem to be carried out at all. Dr. WOHRYZEK has written on this problem of late in the technical press, and here summarizes his proposals for making it evident to some "chemists" that the laboratory is made for the management of the factory, instead of the converse state of affairs. Briefly his proposals depend, as the expression "Super-kontrolle" suggests, on the supervision of the work of the factory chemists by an independent chemist or consultant, or by certain of the staff of the experiment station. Eminent authorities, as Profs. VON LIPPMANN and HERZFELD and Dr. CLAASSEN, have expressed the desirability of instituting some such scheme if the full advantages of chemical control are to be realized, so that it is probable that Dr. Wohryzek's plans may result in rendering a great service to the beet industry at large. Lastly, in regard to the second volume before us, now in its second edition, this differs inappreciably from the first version, the contents of which were not long ago described in these columns.[1]

The Determination of Hydrogen Ions. By W. Mansfield Clark. Second Edition. (Williams & Wilkins Company, Baltimore, U.S.A.) Price: \$5.00 (U.S.A.); \$5.50 (other countries). 1922.

Several contributions which have lately been published in our columns have directed the chemist to the advantages of controlling the reaction of sugar-house juices and liquors by the determination of the hydrogen ion (pH) concentration,

[1] *I.S.J.*, 1921, 694.

notably the valuable paper by BREWSTER and RAINES,[1] of the Experiment Station, New Orleans. It has been shown that the determination of the acidity or alkalinity by titration as generally followed gives results which merely measure the quantity of acid or alkali present in the liquid under consideration, whereas the determination of the hydrogen ion concentration gives an indication of the "strength," or degree to which the liquid is ionized, and thus more precisely controls the danger of the occurrence of inversion or that of the formation of colour. This volume, the publication of the first edition of which was noticed by us at the time,[2] is the standard textbook in the English language on the subject; and discusses very fully its theory and practice. Several processes are available for the determination of the hydrogen ion concentration, but the two which find most acceptance for use in general work are the electrometric and the colorimetric. Of these two, the former is the most precise, but it demands expert attention for operation; and for sugar-house control the colorimetric method, depending on the changes of colour which occur when a series of indicators are subjected to changes of H-ion concentration, is much to be preferred, being easy of execution, rapid, and sufficiently accurate for the purpose in view. A clear and full account is given of the theory of indicators, of the choice of indicators, and of standard buffer solutions (including Clark and Lub's and also Sorensen's), which serve for the colorimetric comparisons in this test, the value of which in the future is certain to be more fully appreciated in the factory and refinery laboratory.

Revised Import Duties on Sugar in India.

The following are the details of the new Indian Tariff valuations on sugar and confectionery which came into force last January:—

	Per	Tariff Valuation.	Duty Per Cent.
CONFECTIONERY		*Ad valorem*	30
SUGAR, all sorts, including molasses and saccharine produce of all sorts, but excluding confectionery (see No. 16)—			
Sugar, crystallized and soft, not inferior to 8 Dutch standard—			
From Java, 23 Dutch standard and above	cwt.	16 4	25
From Java, 16 to 22 Dutch standard	cwt.	14 4	25
From Java, 15 Dutch standard and under	cwt.	13 12	25
From Japan or Formosa	cwt.	18 4	25
Refined in China (including Hong Kong)	cwt.	18 4	25
From Egypt	cwt.	17 4	25
From Mauritius	cwt.	14 12	25
Cane, from other countries	cwt.	14 12	25
Sugar, crystallized, beet	cwt.	16 4	25
Molasses	cwt.	4 0	25
Sugar, all other sorts, including saccharine produce of all kinds	—	*Ad valorem*	25
Sugar candy	cwt.	25 0	25

With regard to the above, it may be observed that opinion in India strongly takes the view that the difference between the import duties on raw and direct consumption sugars is not sufficient to allow Indian refineries to compete adequately with Java white sugars. The result is that sugars of the latter description continue to enter the country freely.

A Reuter's message from Melbourne reports that the Federal Government has decided after all not to renew its arrangement with the Queensland sugar growers when the present contract expires this summer.

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[1] *I.S.J.*, 1923, 88. [2] *I.S.J.*, 1921, 103.

Brevities.

An Australian Royal Commission having recommended a new central sugar mill with a crushing capacity of 150,000 tons in a season of 25 weeks in the Tully River-Banyan area, on the far northern coast in the Herbert district, tenders for its construction will close on Tuesday, July 12th, with the Under-Secretary to the Treasury. Copies of the general arrangement plan, specification, conditions of contract and other particulars are now available at the office of the Agent-General for Queensland, 409 and 410, Strand, London, W.C. 2.

Treacle is the name given in England to molasses, and though the former word is used much less frequently it is of some interest to note the speculations regarding its derivation that are being made.[1] It appears to originate from the Latin word *theriaca*, an antidote against the bite of poisonous animals, and from this word came by phonetic changes, theriacle, triacle (CHAUCER), and treacle (MILTON). Then from being the name of the antidote, it came to be the name of any sweet syrup by which the taste of any nauseous drug was disguised, and one of the old versions of Jeremiah vii, 22, said: "Is there any treacle in Gilead?" to be later rendered in the revised version as "Is there no balm in Gilead?"

In regard to the cost of high-power decolorizing carbons, it is said by some refinery chemists[2] that if these are to prove successful in practice and competition with bonechar, it should be possible to buy them at less than 7½ cents per lb., with bonechar at 5. However, W. H. DUNSTONE, Jr., and B. SANDMANN[3] point out that in the case of "Norit" the yield of finished carbon is only about 30 per cent. of the weight of the raw material, so that if the latter costs $50 per ton, the cost of the raw material per ton of "Norit" works out at $167, to which must be added manufacturing costs, as labour, power, bags, overhead charges, depreciation, interest, insurance and transportation.

The Lots Road Power House of the London Underground Railways has recently had occasion to order another turbo-alternator, of 16,000 k.w. capacity. The large surface condenser required for this has been ordered from the Mirrlees Watson Company, Ltd., of Glasgow, who secured the contract amidst severe competition. The condenser shell is of cast-iron built in sections, 17 ft. long between tube plates. The tubes, 1 in. external diam., are arranged for three passes of circulating water and give a total cooling surface of 29,000 sq. ft. The normal steam duty is 180,000 lbs. per hour, and at this load the vacuum is 29 ins. The auxiliary machinery includes four of the well-known Mirrlees ejector air pumps, three being in use and the fourth a stand-by. These ejectors are arranged to discharge to the feed heater in which practically the whole of the heat in the operating steam is recovered. There are two circulating pumps, either of which takes full duty and has a capacity of 21,000 gallons discharge per min. These pumps are of the vertical spindle type, direct-driven by a Parsons' 500 h p. electric motor, running at 500 r.p.m.

Mr. GEOFFREY FAIRRIE has published another attack on direct consumption sugars,[4] this being "intended as a reply" to the castigations which he has recently received from different sides for his previous remarks on the subject. His intended reply, however, is altogether jejune, being in effect only a repetition of his previous allegations. Taking Demerara yellow crystals (generally acknowledged to be a wholesome and palatable article of food) as his example of a direct consumption sugar, he says that such sugars are "little better than the raw article"; that "there is little to choose between raw and direct consumption sugars"; that 90 per cent. of samples examined contain *Acari*; that they are contaminated with 0·295 per cent. by volume of "dirt"; and so on, along the same lines as his previous inaccurate and misleading statements. He is naturally unable to produce authenticated evidence to support the assertions made; and contents himself with quoting figures supplied by an "independent analyst" and a "leading bacteriologist," both of whom (no doubt for good reasons) remain anonymous. Mr. FAIRRIE appears to be unable to realize the ridiculous attitude which he assumes by these entirely unprovoked attacks on Demerara sugars, since (though his qualifications to pose as an authority on chemical, bacteriological, and dietetic matters are open to question) he is setting himself above the most eminent health authorities in this country, who have had the matter of the wholesomeness of this article of food before them for many years past, and who may well be trusted to attend to their duties without amateur assistance.

[1] *Glasgow Herald*, April 21st, 1923. [2] *Facts about Sugar*, 1922, 14, No. 19, 372. [3] *Ibid.*, 1922, 15, No. 4, 75. [4] *The Grocers' Journal*, March 24th 1923.

Review of Current Technical Literature.[1]

EXPERIMENTS ON THE DEFECATION OF CANE JUICES WITH LIME. *D. J. W. Kreulen.* *Chemisch Weekblad, 1922, 19, No. 40, 409–411.*

Three years ago the writer carried out experiments on the defecation of juice obtained from canes cultivated in the hot-houses of the Landbouw-hoogeschool, at Wageningen, Holland, the particular variety concerned being GZ 1462. His purpose was to ascertain whether the usual method used in Java in the tempering of cane juices could not so be modified as, for example, by previously heating the liquid to a higher temperature than customarily, so as to effect a better clarification.[2] Analysis of the juice from the cane grown under the conditions indicated gave the following figures: Brix, 10·05°; sucrose, 6·24 per cent.; purity, 62·09°; reducing sugars, 0·71, and glucose ratio, 10·93, showing that it was quite an abnormally impure liquid. In place of settling tanks, glass cylinders lagged with cloth, which were previously heated before the lime juice was added to them, were used. Then having ascertained that the volume of calcium sucrate solution of a certain concentration necessary for rendering 250 c.c. of the juice very slightly alkaline to litmus paper was 21·5 c.c., the following three tests were made: (1) 250 c.c. of the juice were treated in a beaker with 21·5 c.c. of the calcium sucrate solution, heated to boiling, and ebullition continued for 20 secs., this being the closest imitation possible of the ordinary defecation procedure as carried out at present in Java. (2) 250 c.c. of the juice were heated to 85° C. (185° F.), and while still heating the 21·5 c.c. of calcium sucrate solution were added, the temperature brought to boiling point, and ebullition continued for 20 secs. (3) 250 c.c. of the juice were preliminarily heated to boiling point, and then the 21·5 c.c. of calcium sucrate solution added, the rest of the procedure being as before. After the liquids had subsided during 35 mins., the cloth which had been wound round the cylinders for their insulation was removed, and the results of the tests were observed. It was then seen that the liquid in Test *3* was by far and away the clearest, being followed by that in Test *2*, and lastly by that in Test *1*. Colorimetric readings of the juice clarified according to the three methods described showed the following results: Test *1*, too cloudy to read; Test *2*, 80°; and Test *3*, 100°; while the weights of the precipitates (after washing with water until the sugar present had been removed) were: Test *3*, 0·588; Test *2*, 0·658, and Test *1*, 0·523 grm. Hence it appears to follow that the clarification had been most complete in Test *3*, and least so in Test *1*, so that considering the example of a factory capable of producing 600,000 litres of juice in 24 hours, the weight of filter-press scum (dried at 100° C.) working according to the procedures followed in Tests *3*, *2*, and *1*, would be about 26·6, 25·4, and 20·2 piculs respectively, or 25·8 per cent. more in the second, and 31·5 per cent more in the third, than in the first method.

Then when in Java similar experiments were performed at the Gempolkrep factory with juices from DJ 52 and GR 100 canes, and the results corroborated those obtained with the abnormally impure liquids in Holland, the following being the figures given by the analyses made of juices clarified according to procedures 1, 2 and 3:—

	Brix.	Sucrose, per cent.	Purity.	Glucose, per cent.	Glucose ratio.	Filter-press Scum, grms.	Ash, grms.	Organic Dry Matter.
DJ 52 ..	19·0	16·75	88·16	0·98	5·85	—	—	—
(1)....	18·61	16·55	89·03	—	—	0·346	0·084	0·262
(2)....	18·59	16·58	89·19	—	—	0·357	0·075	0·282
(3)....	18·44	16·58	89·91	—	—	0·453	0·110	0·343
GZ 100..	18·50	15·92	86·05	1·46	9·17	—	—	—
(1)....	17·82	15·64	87·77	—	—	0·443	0·146	0·297
(2)....	17·82	15·67	87·93	—	—	0·460	0·139	0·321
(3)....	17·75	15·62	88·00	—	—	0·541	0·167	0·374

[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*, 298.

[2] The surmise that a better clarification effect might be obtained by using a higher temperature was due to the late Mr. HARLOFF, while the scheme according to which the tests were carried out was suggested by Mr. VAN DER JAGT.

From which figures it appears that with the juice from DJ 52, Test *3* gave 31 per cent. more scum, and Test *2*, 3·3 per cent. more; while the corresponding values for the juice from GZ 100 were 22 and 3·8 per cent. It further follows from the analyses made that these additional impurities removed were at the expense of organic compounds originally present in the juices, and from the easier "filtrability" of the liquids resulting from Tests *3* and *2*, it was concluded that these organic impurities were of a slimy nature. If, therefore, factories were to adopt the procedure of Test *3*, the advantages which would result, in comparison with the ordinary method of Test *1*, would be: A more rapid subsiding; a clearer juice; a compacter filter-press cake; a quicker filtration; and finally, an easier crystallization of the massecuite and working-up of the centrifugal syrups.

COMPARATIVE EXPERIMENTS BETWEEN VARIOUS DECOLORIZING CARBONS ("NORIT," "DARCO," AND "CARBORAFFIN") AND BONECHAR AT THE MEAUX BEET SUGAR FACTORY. *E. Saillard.* *Circulaire hebdomadaire, No. 1756 of 1922.*

Supplementary to his laboratory experiments with decolorizing carbons,[1] the author has now carried out large scale trials at the Villenoy-près-Meaux factory, France, the purpose in view being to compare the decolorizing power and lime and nitrogen adsorbing power of the carbons selected with that of bonechar. The liquor used was composed of one-third of virgin syrup and two-thirds of a re-melt syrup prepared by dissolving affined after-product crystals in juice from the last carbonatation. In each of the experiments 96 hectolitres of this liquid was used, and to it was added 17·2 kg. of the "Carboraffin," the other carbons being added in proportion to their cost, namely, 26·8 kg. of "Norit," 20·8 of "Darco," and 80·2 kg. of bonechar.[2] The mixing operation was conducted in a tank provided with a steam coil and agitator, and after being stirred for 15 mins. the liquor was heated to 85°C., and filtered through presses, the cloths of which had been "pre-dressed" with a layer of kieselguhr. During the process of filtration, which in each case lasted 40 mins , colorimetric readings were made with the liquors running off, and these compared with the observations obtained with the untreated liquor. Similarly, analyses were carried out before and after the operations described, the results obtained in the cases of the bonechar and "Norit" only being here reproduced :

	BONECHAR.		"NORIT"	
	Liquor before treatment.	Liquor after treatment.	Liquor before treatment	Liquor after treatment.
Sugar per cent. by weight	57·43	58·25	51 55	51·87
Dry matter, true	59·60	60·0	53·20	53·50
Ash	0·70	0·56	0·54	0·54
Purity, true	96·3	97·0	96·9	96·9
Saline coefficient	82·0	104·0	95·4	96·0
Organic matter/ash	2·10	2·12	2 05	2·02
Lime	0·056	0·030	0·047	0·045
Nitrogen	9·15	0·127	0·13	0·122
Colour	100·0	80·0	100·0	78·0

Regarding the decolorizing power shown by the "Darco," this was almost the same as "Norit," viz., 75 per cent. ; while for "Carboraffin" the value was 64 per cent. As to the quantities of lime and nitrogenous substances taken up by the carbons, these varied but little in the case of each, and were always less than in that of the bonechar. Similarly in regard to the mineral matter, the saline coefficient indicated that little of the salts was taken up, and in connexion with this datum it must be remembered that it requires only a slight absorption of salts to send up the saline coefficient to a marked degree. Lastly, the remark is made that in judging these carbons it is necessary to take into consideration, not only the decolorizing effect, but also the quantities of nitrogenous substances and mineral matters that may be adsorbed, since these latter impurities exercise an important influence on the boiling of the products and the crystallization of the sugar.

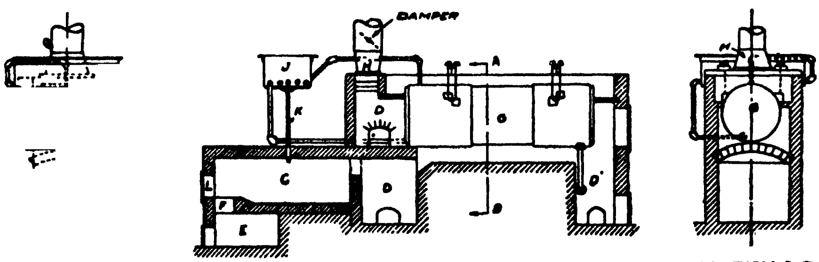
[1] *I.S.J.*, 1922, 474.

[2] The price of these materials is given as follows :—"Norit," 4 fr. ; "Darco," 5 15 fr. ; "Carboraffin," 6·24 fr. ; and bonechar, in fine powder, 1·33 fr. per kg., so that the various quantities of each used in these trials cost 107 fr. 82 for the 96 hl. of liquor under treatment.

Review of Current Technical Literature.

Utilization of Waste Molasses as Fuel, and the Recovery of Potash from the Ashes. *R. Renton Hind. Sugar News, 1923, 4, No. 1, 16-19.*

There are instances, where, due to the absence of distilleries in the vicinity, or to the lack of transportation facilities, it is impossible to market the waste molasses of the sugar factory, so that the burning of this waste product, the utilization of its heat of combustion, and the partial recovery of potash from its ashes, becomes a matter of interest. Hawaiian molasses possesses a thermal value of 4950 B.T.U., as compared with 4455 for bagasse containing 45 per cent. of water; and in certain places in the T.H. light and power during the off-season are derived from steam generated by the use of molasses as fuel. In fact, Hawaii possesses many such plants, all designed with the view of recovering as much potash as possible from the gases of combustion and from the ashes; and generally they consist of a boiler and smoke-stack mounted on a setting having a labyrinth of baffles and



FRONT ELEV. LONGITUDINAL SECTION SECTION A-B

MOLASSES BURNING PLANT FOR RECOVERING POTASH AND UTILISING THE HEAT OF COMBUSTION.

passages through which the gases pass on their way to the stack, giving up in this way at every turn the suspended flakes of potash. Where there is a shortage of bagasse, molasses is often burnt by commingling it with the former fuel at a point behind the last mill of the train, or by atomizing the molasses with steam, very much in the same way as is done in the case of fuel oil. This method of burning the waste product, however, does not allow of as great a recovery of the potash as is obtained in installations in which the recovery of the alkali is of primary and the generation of steam of secondary importance. Generally under such conditions much potash is carried out of the stack. In a molasses burning furnace, it is unnecessary to use extra fuel, except that required to bring the walls to a high heat when the plant is started up, after which the molasses may be said to be "self burning." When the molasses is allowed to drip into the furnace, incandescent zones are soon formed enabling combustion to be carried on, and a similar condition is found when molasses is impinged against a bridge wall with steam atomizers, but the cleaning of the furnace is an operation requiring constant attention, since the slag-like mass which forms is a bar to efficient combustion if allowed to accumulate. Some data concerning a direct combustion molasses furnace, built for potash recovery only, are as follows:—Time of burning, hours, 210; molasses burnt, tons, 140·7; ash in the molasses, per cent., 10·06; potash in the ashes, per cent., 31·18; actual recovery of potash, per cent, 79·34; tons of molasses burnt per ton of K_2O obtained, 40·18. In the accompanying drawing is shown the arrangement of plant for burning molasses under a boiler, and for permitting a maximum recovery of potash, *C* being the oven; *D*, the collecting chambers, *E*, the clinker pit; *G*, the boiler; *H*, the flue connexion; *J*, the molasses supply tank; and *K*, the feed-pipe from tank to oven. It will be noted that the molasses enters the furnace by gravity, though provision for atomization of the fuel can easily be made. Indeed, many modifications of the furnace might be made, and more baffles might be provided with advantage, depending upon the intensity of the draught, the quantity of molasses which is burnt, and the space available for the installation. Generally speaking any central

burdened with an excess of waste molasses can turn this product into a source of profit at a very little outlay. There are no difficulties to surmount, in fact the simplicity of the process recommends itself readily to those who are desirous of utilizing what is often truly a waste by-product.

DOES IT PAY TO REFINE SUGAR IN CUBA? *Editorial.* *La. Planter, 1922, 68, No. 21, 325-326.*

"The question arises, can these plants now operating in Cuba refine at such a cost as to compete in the export trade with the larger refineries of other countries? In reply to this query, we may state, on the basis of our knowledge of the present cost of refining, that we believe it is doubtful if they can. However, we do not know that the relative cost of refining in Cuba and in the United States, for plants of practically equal capacity, is almost identical. The refineries, both modern and antiquated, now operating in Cuba are therefore not sufficiently large to turn out the volume production which would permit them to compete against the larger refineries of the United States. The remedy, then, would appear to be that of increasing the unit capacity in order to reduce unit cost of production. The claim, however, has been made that there are other factors which would operate to prevent refining on a large scale being a financial success in Cuba. Such an assertion cannot very easily be denied, but, at the same time, it cannot any more easily be denied that there exist certain advantages in Cuba for the refining of sugar that probably do not exist anywhere else. Labour at the present time is not any higher than in the United States, although perhaps a bit higher than in some of the European countries. It is true, though, that fuel and the proper quality of water is more or less at a premium. The water in Cuba, as is well-known, is very "hard," but with thorough study and expert advice, that problem can be solved. Practically all fuel oil has to be imported, paying a heavy duty, but it may be that the Cuban Government would make concessions in this regard as well as others for the establishment of the sugar refining industry. Freight on a refined product is usually much higher than on the raw material, but when Cuba exports 3,500,000 tons of 96-test raws each year, there are 140,000 tons impurities shipped out upon which the same freight rate is paid as upon the sucrose contained therein; one may pay a higher freight rate on refined sugar and still gain on the deal. Moreover, of these 140,000 tons of impurities contained in the 3,500,000 tons of raws, there are 17,500 tons of plant food sent out of the country every year, thus to this extent depleting her soil, while by exporting only refined sugar, merely air and water are being transported from her shores. The tariff question also arises, for, in the United States particularly, the import duty on refined sugar is greater than on the raw product. The answer to this tariff question is to export to other countries, at first, and to produce the final product—refined standard granulated sugar—from her cane at such a low cost that the refineries of the United States cannot compete, even in their own markets. But if one will only reflect a moment, he will remember a statement which appeared in these columns some time ago showing that the refiners of the United States are now controlling or producing 33 per cent. of their raw material requirements, thus guarding against that time when all raws produced in Cuba can be refined in Cuba. The tariff, too, they have manipulated to their own interests. As a final answer to the query, does it pay to refine, or will it pay to refine, sugar in Cuba, we reply yes, provided there is volume production great enough to reduce unit cost of production. Then it is only necessary to find a large consuming market."

SUGAR DUST EXPLOSIONS. *W. E. Gibbs.* *Chemical Age, 1923, 8, 54-56; 92-94.*

This is a review of the conditions under which dust explosions are liable to occur; the means of avoiding them; and the effects of the chemical and physical properties of a dust on the explosive phenomena to which it gives rise, these questions being discussed in detail. Some experimental results made with organic dust are given, and a short bibliography is appended.

Review of Current Technical Literature.

Generation of Very High-Pressure Steam. *Anon.* *Chemical Trade Journal, 1923, 257.*

"The higher the steam pressure the more efficient are the results obtained from the point of view of power generation, for the quite obvious reason that the latent heat of steam, expressed as a proportion of the total heat available in the steam lost in the condenser, is reduced. Thus, if the steam pressure is raised from 300 lb. to say 1500 lb., the increase in the power available from a unit of steam is 20–60 per cent., and if the steam at 1500 lb. is used in a back-pressure engine or turbine, and taken out at say 200 lb., for ordinary use, the total net power available can be increased by as much as 100 per cent. Most very high-pressure boilers hitherto designed have been on the principle of very small diameter tubes, so that thin walls can be used for effective heat transmission in spite of the enormous pressures, and an explosion is not serious because of the small water content. This general design is not efficient, partly because of scale troubles, even with nearly pure water, and because the water takes away the heat much more quickly than the steam, so that it is difficult to keep the water in contact with the inside of the tubes. The new "Atmos" boiler is the design of the Swedish engineer, J. V. Blomquist, and these difficulties are got over by generating the steam in continually revolving horizontal tubes. The result of this rotation is that the water inside the tubes is kept pressed against the inside surface of the tubes by centrifugal force, in spite of the fact that water is a better conductor than steam. In addition this action forces the steam bubbles rapidly away from the walls into the open central space of the tubes, from which the steam passes out through a central or internal tube of smaller diameter. The whole design is most ingenious, and is so arranged that there is no leakage at the joints of the rotating tubes, which are also free to expand and contact entirely without strain. The result is further an enormous evaporation, viz., as high as 100 lb. of water per hour per sq. ft. of heating surface. Two boilers have now been working on these lines for the last 12 months continuously at not less than 900 lb. pressure at the Carnegie Sugar Refining Co., Gothenburg, Sweden, and at times the working pressure has been 1500 lb., for which the boilers are designed. Each boiler will generate 16,500 lb. of steam per hour at 1500 lb. pressure and 700° F. temperature, that is 100° F. superheat, and consists of eight rotating tubes, of which a length of 11 ft. 2 in. is exposed to the fires, having an outside diameter of 1 ft. and $\frac{3}{4}$ in. walls. The total heating surface of each boiler is 280 sq. ft., and the rotating tubes are supported in bearings of structural steel work built into brickwork, and worked at a speed of 330 revs. per min. when driven by an 8 h.p. motor. The furnace, after heating the rotating tubes, is then used to heat the superheater, a high-pressure water economizer, and finally a low-pressure water economizer, so that the temperature of the final exit gases is 350–400° F., with 80 per cent. efficiency of steam generation. The feed-water, specially softened, is supplied at 150 lbs. pressure by a centrifugal feed pump, and it is stated that a feature of the joints which naturally have presented extreme difficulties, is a series of packing rings working in oil under pressure."

Determination of Sucrose, Dextrose, and Levulose, individually, using Standard Iodine Solution. *F. A. Cajori.*[1] *Journal of Biological Chemistry, 1922, 54, No. 2, 617-627.*

Miss Judd[2] recently adversely criticized methods using iodine solution, which is presumed to oxidize dextrose to gluconic acid, leaving levulose (and sucrose if present) unaffected, but Baker and Hulton[3] obtained more favourable results. A careful study of the conditions under which sugars are oxidized by iodine has shown the author that the proportions of iodine and of alkali present in the liquid undergoing treatment are of prime importance, and as the result of his findings he has elaborated the following procedure for the determination of dextrose and levulose individually. To 10 c.c. of a solution of the sugars, 2 c.c. of 15 per cent. solution of sodium carbonate were added, then 15 c.c. of an N/1 iodine solution, after which the flask containing the mixture was stoppered and placed in the dark at room temperature for 15 min. Dilute sulphuric acid

[1] Department of Chemistry, Stanford University, California.
[2] *I.S.J.*, 1919, 411; 1921, 50. [3] *Biochem J.*, 1920, 754.

(a 10 per cent. solution) slightly more than that required to neutralize the sodium carbonate present was added, and the iodine titrated immediately with N/20 $Na_2S_2O_3$. In an experiment it was found that 3·82 c.c. of the N/10 iodine solution or 48·5 mgrms. had been reduced, this being equivalent to 34·41 mgrms. of dextrose, whereas 34·56 had been present. If it is desired to determine sucrose, dextrose and levulose individually, in addition to the analyses just described for ascertaining the amount of dextrose, one is made of the amount of the reducing sugars before and after inversion, preferably using Benedicts' reagent,[1] and the technique recently described by SPOEHR,[2] inversion being carried out by the effect of 1 per cent. of hydrochloric acid during two hours at 60°C. Results of analyses of solutions containing the three sugars are given to show that the method described is accurate in the case of the individual sugars within 3 per cent.

ALCOHOL MOTOR FUEL MIXTURES. *H. R. Adam. Journal of the Metallurgical and Mining Society of South Africa, 1922, 23, No 6 (December), 112–118.*

According to the reports of the London General Omnibus Company trials, a mixture of 70 per cent. of alcohol and 30 per cent. of benzol showed an economy as compared with petrol of 24·5 per cent. in B.T.U. When the mixture was 90 : 10 the results were not much inferior,[3] which is important for countries into which the benzol would probably have to be imported. Recent work (particularly that carried out by the Empire Fuels Committee) has shown that the presence of a considerable amount of water in the alcohol used as motor fuel is by no means disadvantageous, and apparently the decreased heat value is compensated for by smoother running and greater efficiency. Whatever may be the exact explanation, the enormous economic importance of this observation is obvious, since 85 per cent. alcohol may be practically as good as 95 per cent. When, however, benzol and petrol are used as additions, the water content of the alcohol is the limiting factor in regard to the proportions which may be used to obtain a miscible solution. Graphs and tables demonstrating this are also shown. Thus, in the cases of 83, 89 and 93 per cent. alcohol, the amount of benzene (pure) which can be added without a turbidity being produced are 37, 59, and 79 per cent., while with 97 per cent. alcohol there is complete miscibility. In regard to petrol (Shell), with alcohol at 84·5, 88·0, 92·5, and 94·0 the respective proportions are 12, 21, 45, and 66 per cent. Benzol or petrol additions favourably affect the vapour pressure from the point of view of starting from the cold, but to what degree (especially in the presence of water) remains to be determined. Coming to ether mixtures, it is remarked that as far back as 1890 mixtures of alcohol and ether were used in France; and a mixture known as "E.H.A." containing alcohol, ether and benzol in the proportions of 65 : 10 : 25 has been used.[4] Ether has a higher calorific value than alcohol (15,000 as compared with 11,000 B.T.U. per lb.), and so for a mixture of alcohol and ether in the respective proportions of 60 and 40 the calorific value would be about 12,000, and a correspondingly greater mileage should be obtainable. Yet it would appear that the same result could be effected more cheaply by the addition of benzol or petrol. A large proportion of ether is considered a drawback for economic reasons.[5] In the manufacture of motor fuel, it is not necessary to make ether free from alcohol, and in a recent patent application it was proposed simply to "etherize" a portion of the alcohol during its distillation. In the U.S.A. a number of mixtures containing kerosene or paraffin oil have been protected. Kerosene has a limited solubility in alcohol, but by the addition of ether, mixtures which are not only homogeneous but have increased volatility are made. Information as to how such complex mixtures behave in running is still rather meagre. Summarizing his discussion, the author remarks that if commercial benzol can be produced in South Africa at a reasonable cost, the lead of France and Germany in using alcohol and benzol mixtures might be followed. Addition of petrol might be undertaken,

[1] *J. Biol. Chem.*, 1908-9, 485. [2] *I.S J.*, 1920, 589.
[3] Refer to : "Gasoline and Kerosene Carburettors," page 29.
[4] SIMMONDS' "Alcohol, its production, properties, and uses," page 384.
[5] *Board of Trade Journal*, September, 1919.

but this is a compromise, and adds to the cost correspondingly. The starting difficulty is not serious, and some simple device for giving a preliminary warming to carburetters would soon be developed. Alcohol alone of 85 to 90 per cent. strength could be used for agricultural and heavy transport work where facilities are provided for running on kerosene, and may be found the most economical in the long run.

VOLUMETRIC DETERMINATION OF SODIUM HYDROSULPHITE. *Anon.* *Chemical Trade Journal, 1923, 72, No. 1886, 224.*

Sodium hydrosulphite, in the presence of an excess of formaldehyde, breaks up into a mixture of sodium sulphoxylate-formaldehyde ($NaHSO_2.CH_2O.2H_2O$) and sodium bisulphite-formaldehyde ($NaHSO_3$ $CH_2O.H_2O$) according to the equation: $Na_2S_2O_4 + 2CH_2O + 4H_2O = NaHSO_2.CH_2O.2H_2O + NaHSO_3.CH_2O.H_2O$. Now, whilst sodium bisulphite-formaldehyde is not acted upon by iodine in neutral or acid solution, sodium sulphoxylate-formaldehyde reacts with the iodine according to the following equation:—$NaHSO_2.CH_2O.2H_2O + 2I_2 = NaHSO_4 + CH_2O + 4HI$. Upon these reactions the volumetric method involving the use of N/10 iodine, and also that of N/10 thiosulphite for back-titration, is based, 1 c.c. of the former being equal to 0·004352 grm. of $Na_2S_2O_4$. In an example a result as high as 98·9 per cent. for commercial hydrosulphite is given.

LOSS OF SUGAR OCCURRING WHEN SWEET-WATER IS USED FOR SLAKING CAUSTIC LIME IN THE BEET SUGAR FACTORY. *Jiri Vondrak.* *Zeitsch. Zuckerind. Cechoslov. Republik, 1923, 47 (iv), Nos. 23 and 24, 311-316, 319-324.*

About two years ago BEYERSDORFER[1] reported the result of experiments on the use of sweet-water for the slaking of the caustic lime for the defecation of beet juices, according to which tests the amount of sugar destroyed varied from 3·5 to 15·4 per cent. of that originally present. His procedure was to prepare a solution containing 26 grms. of sucrose in 500 c.c. of water, heat it to 70° C., treat it with 100 grms. of freshly burnt lime in small lumps, carbonate to neutrality at 80° C., and finally filter, the sugar being determined in both the filtrate and in the scums, and compared with that originally found to be present. Mr. VONDRAK has taken up this question, but is not able to confirm the findings of the German chemist. In the first place he carried out large-scale experiments in two different factories on the use of sweet-waters (containing about 5 per cent. of sucrose) for the slaking of the caustic lime, careful analyses being made of the milk-of-lime thus produced, and likewise of the milk after it had been carbonated. It was then observed that the purity ratio of the milk remained practically unaffected; and further that its content in soluble lime salts has risen only to an insignificant extent, whereas had decomposition occurred an appreciable amount of calcium lactate could have been detected. Secondly, a series of laboratory experiments confirmed the conclusion that the degree of decomposition is not great, being at most about 2·8 per cent. of that originally present. Beyersdorfer's experiments were repeated; and it was concluded that they had involved a source of error, namely in the determination of the amount of sugar remaining in the scums. Three different methods have been prescribed officially in different countries for this purpose, the first two comprising decomposition of the calcium saccharate with a solution either of ammonium nitrate or else of zinc nitrate; while in the third sufficient acetic acid is added partly to decompose the calcium carbonate present. Parallel experiments are now stated to have proved that all three give much too low results; and that a correct determination of the sucrose in carbonatation scums is only possible by the complète solution of the calcium salts in dilute acetic acid. Of course, when an insufficient amount of sweet-water is used for the slaking of lime (as with a ratio of water to lime of 1 : 1) a high loss such as that stated by BEYERSDORFER may occur; and then, in fact, it may amount to about 13 per cent.

J. P. O.

[1] *I.S.J.*, 1912, 292.

Review of Recent Patents.[1]

UNITED KINGDOM.

DUMBTURNERS FOR CANE MILLS. *Charles McNeil, B.Sc.*, of Colonial Ironworks, Govan, Glasgow. *193,239.* March 3rd, 1922. (Four figures; six claims.)

As usually constructed, the dumbturner plate is checked on its under side into the upper surfaces of its carrying bar so that it and the carrying bar are moved together as one piece to and from the front roll on movement of the adjusting wedges; and the invention has for its object to improve the construction of the dumbturner plate and carrying bar so that the dumbturner plate itself may be separately adjustable relatively to the rolls irrespective of the adjustment of the carrying bar, the invention being applicable to either the rocker bar type of dumbturner or to what is known as the fixed bar type. A dumbturner plate made according to the invention comprises essentially a carrying bar adjustably held as usual by wedges acting between parts on the bar and projections on the mill housings, and a dumbturner plate separate from the carrying bar, means for separately adjusting this plate relatively to the rolls irrespective of the adjustment of the carrying bar, and means for holding the dumbturner plate on the upper surface of the carrying bar.

As is shown in Figs. 1 and 2, the dumbturner plate *A* extends laterally beyond the usual flange *B* on the upper roll *B1* of the mill, and the flange extends into a groove *A1* in the upper surface of the plate. The under surface of the plate is inclined from the front upwards towards the rear and rests on the inclined portion *C* on the upper surface of the carrying bar *C1*. Transverse dovetailed ribs *A2* on the under side of the plate engage in slots *C2* in the top of the bar. A wedge face *A3* oppositely inclined to the underside of the plate is formed on the upper surface at each end of the plate, and inclined wedges *D* are placed between the faces *A3* and projections *D1* on the inner faces of the housings. The wedges are provided at their forward sides with rods *D2* which extend out to the front of the mill where they pass through lugs *D3* and are fitted with nuts *D4*. Rods *E* extend from the rear of the plate *A* at each end to lugs *E1* towards the rear of the housings where they are provided with adjusting-nuts *E2*. The bar *C1* is adjustable as usual by wedges *G* carried by adjusting-bolts *G1* which pass through lugs *G3* on the inner face of the housing. In use, when the gap between the front lower roll and the upper roll B^1 has been adjusted in usual manner, and when the wedges *G* holding the carrying bar C^1 have been screwed up to hold that bar rigid as usual, the rods *E* extending rearwards from the dumbturner plate *A* are adjusted until the forward knife edge on that plate is bearing on the surface of the front roll; then the wedges *D* bearing on the wedge faces A^3 on the opposite ends of the upper side of the plate *A* are also tightened up. This tends to impart a forward pull to the plate and thus ensures that when the cane is passing through between the lower and upper rolls there will be no tendency for the cane to get between the lower front roll and the knife edge of the plate, and thus damage it.

FIG. 1.

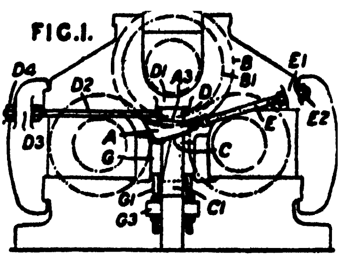
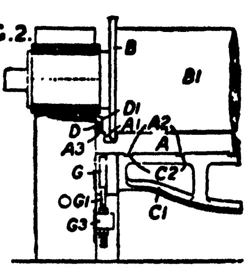


FIG. 2.



[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

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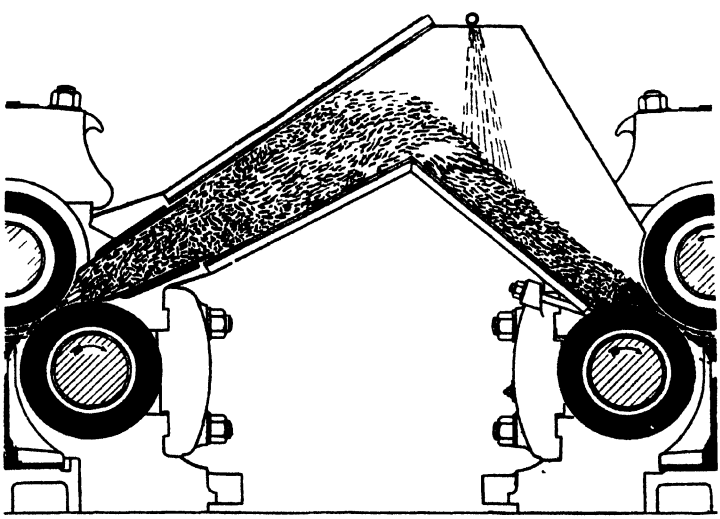

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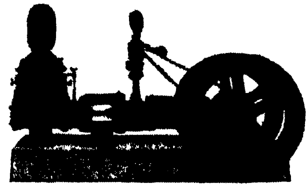

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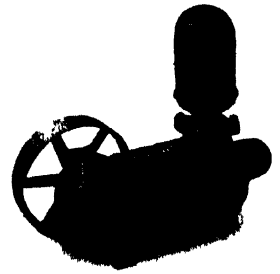
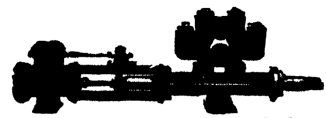


Motor Pump.



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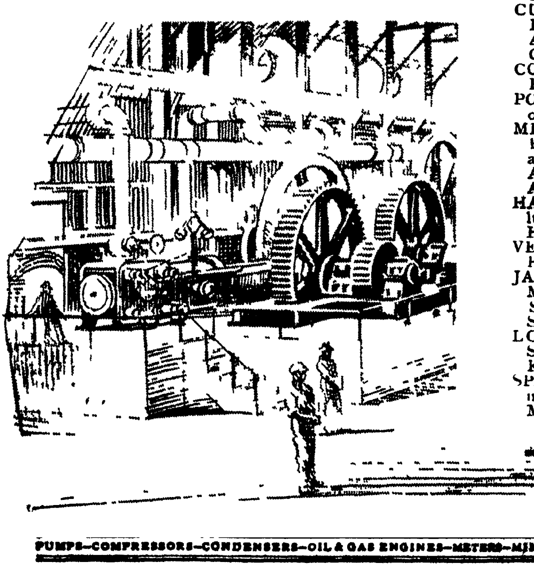

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PUMPS—COMPRESSORS—CONDENSERS—OIL & GAS ENGINES—METERS—MINING—ROCK CRUSHING & CEMENT MACHINERY

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Also, should the usual horizontal bolts (not shown) holding the headstock side caps stretch when the mill is in use, as they may do, and thus alter the position of the front roll relative to the plate *A*, further adjustment of the dumbturner plate *A* itself is readily effected without stopping the mill, which it is necessary to do with existing constructions (where the plate and its carrying bar move as one) in order to get below the mill to the bolts G^1 carrying the usual adjusting wedges *G* for the bar C^1. In a modification of this invention, the dumbturner plate is held down on the upper part of the carrying bar by screwed rods tapped into the underside of the plate and extending through slots in the bar.

Clarification of Liquids by Adding Precipitates. *J. N. A. Sauer*, of Amsterdam. (1) *183,485*. July 24th, 1922; convention date, July 23rd, 1921. (2) *184,473*. August 9th, 1922; convention date, August 9th, 1921.

(1) Sugar juices, water, etc., are clarified by adding precipitated lime salts and then filtering; calcium carbonate, sulphite, sulphate, phosphate, oxalate and tartrate are mentioned as suitable. The process can be employed in combination with the known processes for softening water by means of zeolites and other base-exchanging reagents. The precipitation may be effected at different temperatures, yielding different sizes of crystals, which are appropriate to different processes. Alkalies may be added to reduce the acidity of the liquid or produce any desired degree of alkalinity. Different salts may be used together or in succession. The residue from filtration may be purified by ignition or by treatment with hydrochloric acid and re-used.

(2) Liquids such as sugar and glucose syrups and solutions, mineral oils and greases, benzine, spirits, water, alcohol, and glycerine are purified by treatment with a precipitate of an insoluble material formed outside the liquid and afterwards removed by filtration. The precipitates are especially effective in removing substances that have a chemical similarity to them, e.g., calcium phosphate will remove calcium compounds and phosphates, calcium carbonate will remove calcium compounds and organic compounds. The precipitate can be produced in any known way and at a higher or lower temperature as a coarser or finer precipitate is required. The process may be used in combination with other known processes, e.g., sugar solution may be treated with sulphurous acid and then with calcium carbonate, or decolorizing substances, such as decolorizing carbon or bleaching earth, may be employed along with the precipitate. The precipitate is preferably used when freshly precipitated, but it may be revivified after use and re-used. When this is to be done the material treated is preferably first freed from coarse impurities by filtration, decantation, etc. The precipitates may be dissolved wholly or in part, and reprecipitated; or ignited or washed with a dilute acid or alkali, or these methods may be used in combination. The liquid may be treated with an electric current during purification or catalysts or electrolytes added.

Production of Barium Hydrate. *J. Michael & Co.*, of Berlin. *192,415*. January 29th, 1923; convention date, Berlin, January 27th, 1922.

Barium sulphide is dissolved in hot water and cooled to obtain hydrated crystals, which are separated, heated to 20–100°C., dissolved in hot water, and the solution cooled to obtain crystals of barium hydrate, barium sulphydrate remaining in solution. In an example, the barium sulphide crystals are heated to 75°C. until the colour becomes yellow, dissolved in hot water, and the solution is cooled to the ordinary temperature.

Filtering Juice. *J. Duclaux*, of Paris. *190,143*. December 5th, 1922; convention date, December 6th, 1921.

Juice (from fruit, etc.) is filtered through a membrane "of the nature of cellulose," such as nitro-cellulose, viscose, cellulose acetate, or denitrated cellulose, or through any membrane having the properties of an ultra-filter.

UNITED STATES.

MILL FEED CONTROLLER. *Edward G. Koch*, of Bayou Goula, Louisiana (Assignor to *Harry A. Nadler*, of Plaquemine, Louisiana). *1,445,218.* February 13th, 1923. (Two figures; and four claims.)

A swinging rake is employed as the means by which a substantially regular volume of feed to the mill may be secured. Referring to the figures, *A* represents the cane carrier in the form of an endless belt which travels between the fixed side walls or rails *B*. Certain of the slats *a* of this carrier may be provided with cleats *a'*, if desired, which cleats should preferably be staggered as shown in Fig. 2. This carrier is driven in the usual or in any convenient way; the mode of driving same being well known in the art need not be further described herein. *C* represents the delivery chute for delivering the cane from the end of the carrier to the crusher rolls *D*, which crusher rolls may be of any preferred type. Projecting down between the side walls of said chute, cane holding or arresting mechanism, comprising a rake *E* having a series of tines *e* rigidly attached to the shaft *e'*, is provided. These tines are curved, as at e^2, the whole forming a pivoted rake or holder somewhat similar to those used on harvesters. Engaging the back of this rake is a movable beam *F*, forming with the side brackets *F'* a rectangular yoke, the ends of which side brackets are connected by the connecting rods *G* to the piston rods *H*, fast to the pistons *H'* of the cylinders *I*. To prevent sagging of the piston rods, a sliding support *J* may be provided, fast at one end to the piston rod and having its other end sliding on the guide rod *K* which has one end fast, as at *k*, to the cylinder, and the other end secured, as at *k'*, to the framework of the apparatus. The cylinders may be secured to the side walls of the carrier in any convenient way, as by the brackets *M* and bolts *m'*.

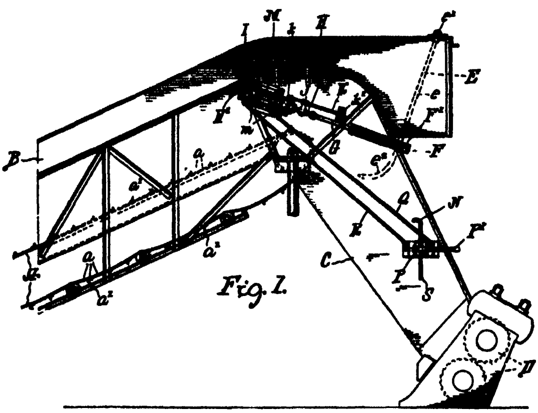
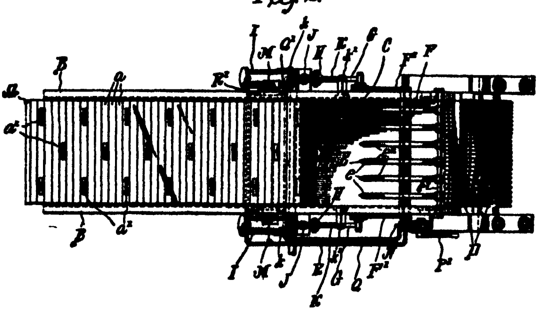


Fig. 2.



In Fig. 1 the rake is shown in the lifted position for narrowing down the throat through which the feed cane passes from the carrier to the crushers. The pistons are moved in the cylinders by fluid pressure, as water pressure, steam pressure, or the like, and the fluid pressure is shown applied through the pipe *N* to the valve *P*, which is controlled by the hand lever *P'*. This valve directs the fluid through the pipe *Q*, moving the piston in the direction for lifting the rake, and through the pipe *R* in the direction for lowering the rake. The fluid is exhausted through the exhaust pipe *S*. It will be seen, however, that it will only be necessary to use any appreciable amount of fluid pressure for lifting the rake, as the weight of the cane thereon and also the weight of the parts will tend to restore the rake to the lowest position under the action of gravity. The fluid

pressure is applied to the two cylinders simultaneously, and for this purpose branch pipes *R'* and *Q'* are shown as connected to the second cylinder (see Fig. 2), which is on the opposite side of the apparatus from the first cylinder shown in Fig. 1. A single cylinder with the proper mechanism operated thereby may be used to swing the rake; although two would ordinarily give a better balanced result. In the operation of the device, the operator regulates the feed of the cane carried to the mill by swinging the rake to the desired position. This rake will engage the top layer of the feed cane as it passes down the chute and may be eased off to feed more cane, or swung upwards to feed less, as desired. It is a simple matter for the operator to learn by experiment the position of the rake which gives the best results under the conditions prevailing at any given mill.

ROTARY SUCTION FILTER. *Ernest J. Sweetland*, of Montclair, Essex, New Jersey. *1,432,134*. October 17th, 1922. (Nineteen figures; and thirty-five claims.)

In the plate-and-drum types of rotary suction filters which have been previously used, it is the universal practice to rotate the filter elements at a slow uniform speed, sometimes as slow as one revolution in 10 or 12 mins. According to the present invention, the filter element is rotated with an intermittent movement and permitted to remain stationary for an appreciable period of time between the movements thereof. If there are 10 segments or filter areas in the disc or drum, and the disc or drum is timed to make one complete revolution in 10 mins., each segment or filter area might be timed to advance one step in each minute. This might be arranged so that each movement would require a period of about 10 secs., after which the filter would remain stationary for 50 secs. A reverse flow of compressed air is ordinarily passed through each segment or filter area as the cake is removed therefrom, and according to the present construction this flow of compressed air will only be necessary for a period of 10 secs., thereby very greatly reducing the compressed air consumption and obtaining a filter of increased capacity. The present invention further contemplates a mounting of the spraying nozzles whereby they are oscillated or moved and relative motion obtained between the nozzles and the filter members, even though the leaves or drum may be at rest. The spray from the nozzles is thus distributed over the filter areas and an even wash accomplished. Another important feature of the invention is the utilization of pressure to expel the moisture from the cake or sludge preparatory to the discharge thereof. One of the greatest drawbacks to the use of suction filters has always been that it is impossible to get the cake as dry by suction as it can be obtained in pressure filters, and in many instances it has been impossible to effect the sale of suction filters on this account. The intermittent motion of the filter enables pressure to be applied directly to the filter cake during those periods when the filter is at rest, and any suitable mechanical, pneumatic, or hydraulic means may be utilized for subjecting the cake to pressure while still in position upon the filter and reducing the moisture content thereof to the lowest possible point. One of the great objections to suction filters is removed in this way. The invention also contemplates the provision of removable and interchangeable scrapers which can be replaced as frequently as necessary without delay and inconvenience.

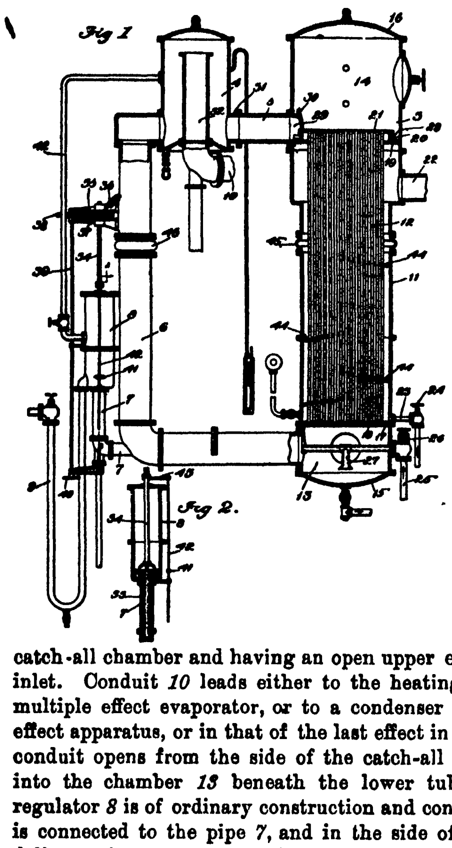
SLUICING MECHANISM FOR FILTERS, ESPECIALLY THE SWEETLAND. *Robert C. Campbell*, of Millbirn, New Jersey (assignor to *United Filters Corporation*, of New York). *1,430,518*. September 25th, 1922. (Three figures; 17 claims.)

Claim 17.—Sluicing mechanism for filters comprising a sluicing pipe having a screw thread thereon, a rotatable nut engaging said screw thread and held against longitudinal movement, means for oscillating said pipe, actuating means operatively connected to said pipe and to said nut, means adapted alternately to hold said nut against rotation in opposite directions whereby longitudinal reciprocation of said pipe is effected and means for automatically causing said holding means to occupy its alternate positions as said pipe reaches the limit of its travel.

BEET BLOCKING AND THINNING MACHINE. *Steve R. Yozits and Wm. G. Zabel*, of Oshkosh, Wis., U.S.A. *1,440,120*. December 26th, 1922.

EVAPORATOR. *Alfred L. Webre,* of Winchester, Mass., U.S.A. *1,436,739.* November 28th, 1922. (Two figures; five claims.)

Referring to Fig. 1, the evaporator unit described in this invention (the objects of which are set forth later) comprises an evaporator *3*, a catch-all *4*, a conduit *5* leading from evaporator to catch-all, a return-pipe *6* from catch-all to evaporator, a draw-off pipe *7* from the return-pipe, a level regulator *8*, a discharge pipe *9* from the level regulator, and a vapour outlet conduit from the catch-all. In regard to the evaporator it should be noted that the lower tubular section has an inwardly projecting ledge *17* on which the periphery of the bottom tube sheet *18* rests; while the upper section has an inwardly projecting ledge *19* supporting an annulus *20* on which the edge of the upper tube sheet *21* rests. The lower tube sheet has a diameter sufficiently smaller than the opening within the ledge *19* and annulus *20* to allow it to pass through such opening, thereby permitting the entire tube bundle to be withdrawn from the shell when the upper head *16* is removed. Also, the evaporator is provided with an inlet *22* for the heating steam; an outlet *23* for the condensate; a supply pipe *25* for the juice to be evaporated, which pipe communicates with an inlet *27* in the shell below the tube bundle, and is controlled by a valve *26*. Between the annulus *20* and the shell is an annular space *28*, and the opening *29* in the side of the shell which registers with the conduit *5* is, as to its lowest part, on the same level with this annular space, while its upper part is above the level of the tube sheet *21*. In other words, the tube sheet is above the annular space *28* and between the upper and lower limits of the outlet opening *29*. A guard *30* forms a gutter which overlies the opening *29* adjacent to the shell, and extends at both ends into the annular space *28* at opposite sides of said opening. Catch-all *4* is a chamber having an inlet opening in one side near the lower end leading to a nipple *31* which is connected to the conduit *5*. The vapour discharge conduit is connected to a stand pipe *32* inside the catch-all chamber and having an open upper end which is above the level of the catch-all inlet. Conduit *10* leads either to the heating space of the next effect, in the case of a multiple effect evaporator, or to a condenser or the atmosphere in the case of a single effect apparatus, or in that of the last effect in the multiple effect apparatus. The return conduit opens from the side of the catch-all below the orifice of standpipe *32* and leads into the chamber *13* beneath the lower tube sheet of the tube bundle. The level regulator *8* is of ordinary construction and consists of a chamber, the lower part of which is connected to the pipe *7*, and in the side of which there is an outlet wherefrom the delivery pipe *9* passes. Fitting telescopically in the rising part of the pipe *7* is a tube *33*, the upper end of which is connected to a rod *34* passing through the top of the chamber *8* and being movable endwise This rod is threaded in part and passes through a nut *35* supported by a bracket *36* attached to the side of the conduit *6*. A gear wheel *37* is secured to the nut *35* and meshes with a gear wheel *38* on a shaft *39* which is equipped with a handwheel *40*. Evidently by turning this handwheel, the nut may be rotated, and rod *34* thereby moved to raise and lower the telescopic tube *33*, whereby the level of the liquid in the evaporator may be regulated, since such liquid will not overflow the



telescopic tube until its level in the evaporator is at or above the level of the upper end of this tube. At *41* is an indicating pointer outside the level regulator chamber, carried by a rod *42* which is attached to an arm *43* fixed to the rod *34*; *42* represents a conduit leading from the catch-all to the level regulator to equalize the pressure in the latter with that of the rest of the apparatus. In the evaporator there are one or more inclined baffle plates *44* through which the tubes pass and in which they fit closely, and the function of the baffles is to conduct away the water of condensation which tends to collect on the tubes. In the shell of the evaporator is an expansion joint *45*, and in the conduit *6* is an expansion joint *46*; the purpose of these joints being to compensate for unequal expansions and contractions of different parts of the apparatus with temperature changes.

One feature of the invention resides in the fact that the draw-off outlet is located in the return conduit, so that it conducts away liquor of the greatest concentration, and before the returning liquor has become diluted by admixture with liquor admitted through the inlet. Aside from the fact that this draw-off pipe must be located at some point in the return conduit, the only feature limiting its position is that it must be below the level of the liquid in the evaporator, so that it will be filled with clear liquid, that is, the liquid which passes to it will not be mingled with vapour. Practically the most convenient point for the location of this pipe is at the angle between the rising part of this conduit and the horizontal run to the evaporator. Another feature is the means which prevents the collection of a body or layer of liquid over the upper ends of the tubes *12*, and comprises the annular collection space *28* and the elevation of the upper tube sheet *21* above the bottom of the chamber *14*. As the liquor is ejected from the tubes by the force of the expanding vapour, it is thrown outwardly to the walls of the chamber, and most of it flows down along the walls into the annular space *28*, and only a small proportion falls backs directly upon the tube sheet. The liquid collected in this space cannot overflow upon the tube sheet, because it escapes through the outlet *29* and conduit *5* as fast as it collects in the annular space. Thus the outlet openings of the tubes are kept clear, and neither is the outflow of liquor and vapour therefrom impeded by a superimposed layer of liquid, nor is a body of liquid maintained in constant agitation by jets issuing from the tubes, as would be the case if liquid were allowed to collect above the tubes. The result is that free flow from the tubes, without unnecessary back pressure, is permitted, and that the separation between vapour and liquid becomes almost complete in the evaporator itself.

Vapour Box or Still for Use in the Distillation of Alcohol. *Francis M. Hess*, of Whiting, Ind., U.S.A. *1,443,743*. January 30th, 1923. (Five claims.)

Claim 1.—In a distilling apparatus, a vapour-box comprising a casing having top and bottom openings for the introduction and discharge respectively of the crude material, and a series of alternately-arranged and oppositely-inclined, broad, flat, imperforate heating plates extending cross-wise of said casing and producing a zig-zag path of flow for the crude material, said plates being hollow to permit the flow of a heating agent therethrough.

Production of Barium Carbonate. *James H. MacMahon* (assignor to *The Mathieson Alkali Works, Inc.*, Virginia, U.S.A.). *1,444,623*. February 6th, 1923. (Three claims.)

Claim 1.—Method for the commercial production of barium carbonate which comprises reacting upon barium sulphide with the ammonium carbonate in the liquor coming from the bicarbonate filters of the ammonia-soda process, to precipitate barium carbonate.

Motor Fuel containing Alcohol. *Miguel Llompart y Valdés and Vicente Bacallao y Villar*, of Habana, Cubu. *1,448,245*. March 13th, 1923. (Two claims.)

Claim is made for a liquid combustible constituted by nitro-benzol, ethyl alcohol, and nitrous ether.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending March 31st. 1922. Tons.	1923. Tons.	Three Months ending March 31st. 1922. Tons.	1923. Tons.
UNREFINED SUGARS.				
Poland	....	.	....	....
Germany	....	....	....	....
Netherlands	....	....	....	....
Belgium	....	....	....	...
France	....	..	....	....
Czecho-Slovakia		....		...
Java	..	298	1	9,939
Philippine Islands	....	....	....	....
Cuba	103,219	39,940	191,812	39,948
Dutch Guiana	652	185	1,461	983
Hayti and San Domingo	....	....	....	....
Mexico	...	..	....	....
Peru	2,876	5,960	24,213	38,132
Brazil	5,697	5,495	16,072	41,462
Mauritius	1,005	30,805	56,311	111,598
British India	....	375	....	375
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	8,211	3,413	24,788	8,431
Other Countries	6,202	8,535	13,528	13,990
Total Raw Sugars	**127,863**	**95,008**	**328,187**	**264,859**
REFINED SUGARS.				
Germany	....	. .	....	....
Netherlands	2,254	2,092	10,152	12,198
Belgium	281	909	2,183	8,329
France	....	14	....	142
Czecho-Slovakia	1,087	7,924	18,133	27,678
Java	....	....	1	2,460
United States of America	21,507	7,117	47,118	9,808
Canada	3,309	2,229	8,150	3,123
Other Countries	319	1,975	868	7,940
Total Refined Sugars	**28,757**	**22,260**	**86,607**	**71,677**
Molasses	4,268	13,346	21,171	46,127
Total Imports	**160,888**	**130,614**	**435,965**	**382,663**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark	100	26	261	269
Netherlands	421	113	963	423
Portugal, Azores and Madeira	....	....	....	....
Channel Islands	79	84	255	341
Canada	....	....	....	....
Other Countries	1,791	520	4,001	1,484
	2,391	744	5,480	2,517
FOREIGN & COLONIAL SUGARS				
Refined and Candy	891	294	412	742
Unrefined	114	5,252	1,339	7,292
Various Mixed in Bond	....	....	....	....
Molasses	65	37	379	980
Total Exports	**2,961**	**6,327**	**7,610**	**11,531**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922. Tons.
Total Receipts, January 1st to April 25th	1,271,933	..	1,384,416
Deliveries ,, ,, ...	1,250,657	..	1,346,652
Meltings by Refiners ,, ,, ...	1,068,010	..	1,167,178
Exports of Refined ,, ,, ...	68,000	..	167,000
Importers' Stocks, April 25th	21,276	..	37,764
Total Stocks, April 25th	211,892	..	234,858
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1920-21. Tons.		1921-22. Tons		1922-23. Tons.
Exports	767,010	..	818,697	..	1,469,037
Stocks	776,224	..	799,619	..	653,692
	1,543,234		1,618,316		2,122,729
Local Consumption	30,000	..	30,000	..	30,000
Receipts at Port to March 31st	1,573,234		1,648,316		2,152,729

Havana, March 31st, 1923. J. GUMA.—L MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR THREE MONTHS ENDING MARCH 31ST, 1921, 1922, AND 1923.

IMPORTS.	1921. Tons.		1922. Tons.		1923. Tons.
Refined... ..	53,274	..	86,607	..	71,677
Raw	202,901	..	328,187	..	264,859
Molasses . ..	20,322	..	21,171	..	46,127
	276,497		435,965		382,663

EXPORTS	1921. Tons.		1922. Tons.		1923. Tons.
Refined........	14	..	412	..	743
Raw...........	509	..	1,339	..	7,292
Molasses	191	..	379	..	980
	714		2,130		9,015

HOME CONSUMPTION.

	1921. Tons.		1922. Tons.		1923. Tons.
Refined	47,410	..	86,146	..	73,632
Refined (in Bond) in the United Kingdom	257,178	..	225,250	..	218,592
Raw	29,774	..	39,027	..	29,918
Total of Sugar	334,362		350,423		322,142
Molasses..	2,875	..	1,652	..	2,013
Molasses, manufactured (in Bond) in United Kingdom .	12,573	..	13,341	..	14,430
	349,810		365,416		338,615

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT MARCH 31ST, 1921, 1922, AND 1923.

	1921. Tons.		1922. Tons.		1923. Tons.
Refined in Bond	25,950	..	31,350	..	68,900
Foreign Refined	34,800	..	12,350	..	27,050
,, Unrefined..	264,000	..	169,800	..	182,950
	324,750		213,500		278,900

Sugar Crops of the World.

(Willett & Gray's Estimates to April 19th, 1923.)

	Harvesting Period.	*1922-23. Tons.	1921-22. Tons.	1920-21. Tons.
United States—Louisiana	Oct.-Jan.	215,000	289,669	150,926
Texas	,, ,,	2,875	2,920	6,238
Porto Rico	Jan.-June	350,000	362,442	438,494
Hawaiian Islands	Nov.-July	467,000	502,194	504,073
West Indies—Virgin Islands	Jan.-June	6,000	5,000	4,500
Cuba	Dec.-June	4,000,000	3,996,387	3,936,040
British West Indies—Trinidad	Jan -June	55,000	59,948	54,933
Barbados	,, ,,	50,000	36,742	24,817
Jamaica	,, ,,	38,000	42,167	39,960
Antigua	Feb.-July	12,000	9,850	11,320
St. Kitts	Feb.-Aug.	15,000	8,426	8,063
Other British West Indies	Jan.-June	10,000	9,238	3,603
French West Indies—Martinique	Jan.-July	19,700	18,329	23,834
Guadeloupe	,, ,,	30,000	32,000	25,426
San Domingo	Jan.-June	200,000	225,000	185,546
Haiti	Dec.-June	12,000	12,283	5,625
Mexico	,, ,,	120,000	119,800	115,000
Central America—Guatemala	Jan.-June	20,000	19,090	17,500
Other Central America	,, ,,	28,000	27,972	36,692
South America—				
Demerara	Oct.-Dec. and May-June	100,000	107,797	96,168
Surinam	Oct. Jan.	11,000	10,000	9,394
Venezuela	Oct.-June	16,000	16,000	22,806
Ecuador	Oct.-Feb.	8,000	7,000	6,998
Peru	Jan.-Dec.	340,000	319,864	344,024
Argentina	May-Nov.	200,000	172,236	202,158
Brazil	Oct.-Feb.	425,000	491,933	340,063
Total in America		6,750,575	6,904,287	6,614,271
Asia—Brit. India (consumed locally)	Dec.-May	2,875,000	2,532,000	2,506,320
Java (1923-24, 1,720,000)	May-Nov.	1,750,000	1,649,610	1,508,755
Formosa and Japan	Nov.-June	405,800	406,966	342,176
Philippine Islands	,, ,,	285,000	338,160	255,843
Total in Asia		5,315,800	4,926,736	4,613,094
Australia	June-Nov.	300,000	298,701	182,401
Fiji Islands	,, ,,	52,000	65,000	73,000
Total in Australia and Polynesia		352,000	363,701	255,401
Africa—Egypt	Jan.-June	90,000	100,000	79,706
Mauritius	Aug.-Jan.	233,500	182,234	259,872
Réunion	,, ,,	40,000	55,564	42,688
Natal (1923-24, 200,000)	May-Oct.	141,260	146,983	155,194
Mozambique	,, ,,	45,000	34,446	51,009
Total in Africa		549,760	519,227	588,469
Europe—Spain	Dec.-June	6,000	5,000	6,886
Total cane sugar crops		12,974,135	12,718,951	12,078,121
Europe—Beet sugar crops		4,603,690	4,049,821	3,681,461
United States—Beet sugar crop	July-Jan.	615,000	911,190	969,419
Canada—Beet sugar crop	Oct.-Dec.	15,000	18,931	34,600
Total beet sugar crops		5,233,690	4,979,942	4,685,480
Grand total Cane and Beet Sugar	Tons	18,207,825	17,698,893	16,763,601
Estimated increase in the world's production	,,	508,932	935,292	1,563,200

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INTERNATIONAL

SUGAR JOURNAL.

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No. 294. JUNE, 1923. VOL. XXV.

Notes and Comments.

The Changes in the Government.

It was generally known that Mr. Bonar Law's acceptance of the Premiership last November was contingent on his remaining in good health, but it was hoped that he would be able to stand the strain of office. Unfortunately this did not prove to be the case and, after taking a holiday in April and the beginning of May in an effort to get rid of some persistent throat trouble, his condition became such that he had no option but to tender his resignation to the King. This decision was come to at such short notice that the country was taken by surprise. But the new Premier was quickly found. By virtue of seniority in his party and in view of his distinguished services to the country, LORD CURZON, the Foreign Secretary, seemed entitled to the position, and 15 years ago would have been chosen without a doubt. But there is now so strong a feeling that the Premier must be a House of Commons man, in which House the principal Opposition to the Government, that of Labour, is seated and from which chamber of course a Peer is rigidly excluded by the constitution, that no surprise or dissent was expressed when the King sent for Mr. Bonar Law's "second in command," Mr. STANLEY BALDWIN, Chancellor of the Exchequer, and invited him to accept the Premiership. This Mr. BALDWIN agreed to do and he quickly made up his Cabinet, effecting as few changes as possible in the existing personnel.

Mr. BALDWIN is a comparatively new man, but he has shown very high ability in the short time he has been a Cabinet Minister. His success in funding the American Debt last year and his sound Budget of 1923 have been generally praised, and the country has generally approved the King's choice. The new Premier is an experienced business man, having been in earlier years head of a big iron and steel firm (Messrs. Baldwins Ltd.), and the commercial community will look forward to having their interests safeguarded in a more practical manner than frequently proves the case when lawyer politicians are in power. One step in forming his Cabinet has been characteristic of Mr. BALDWIN. The Chancellorship of the Exchequer becoming vacant by his accession to the Premiership, he first tried to secure an ex-chancellor in the person of either Mr. CHAMBERLAIN

or SIR ROBERT HORNE, Conservatives who on the fall of Mr. Lloyd George's Coalition Government felt bound as a protest to follow their leader into temporary exile. But the feeling of the party was so strongly against Mr. CHAMBERLAIN being asked to join the Cabinet at this juncture that Mr. BALDWIN had to refrain from offering him the vacant post, while SIR ROBERT HORNE preferred not to abandon some important business interests he had just entered into. Mr. BALDWIN then approached another strong financier, in the person of Mr. REGINALD McKENNA, an Ex-Cabinet Minister of a former Liberal Government, who has been for some years head of one of the biggest banks in London. Mr. McKenna's political views would appear to have veered round since he forsook politics for business in 1916, and he might now be classed as a free trade Conservative. His position in the financial world is however so strong and his experience so wide, that it was a wise step to invite him to be the new minister of finance at a time when the very best brains are needed to help to smooth out the tangle of European financial affairs. He has accepted Mr. Baldwin's invitation and is to join the Cabinet as Chancellor of the Exchequer before very long. Another new inclusion in the Cabinet is LORD ROBERT CECIL, the life and soul of the League of Nations.

The effect of these changes is to strengthen greatly a Government that was somewhat weak in debating power and in Parliamentary experience. Moreover, thanks to Mr. Baldwin's conciliatory attitude, it is probable that those Conservative members of the last Coalition Government who out of loyalty to Mr. LLOYD GEORGE have held aloof since last December from participation in the Government will shortly return to the party they have all along really belonged to, while it is rumoured that even Mr. CHURCHILL himself may shortly revert to the fold he left some 20 years ago. Nowadays, the difference that separates Conservatism and Liberalism is a mere ditch as compared with the wide gulf that divides them both from the socialistic aspirations of Labour, and free trade is their main bone of contention. Mr. BONAR LAW had laid it down during his term of office that the country is not at present prepared to consider an extension of tariffs, and Mr. BALDWIN, though a Tariff Reformer at heart, doubtless realizes that this is not the time for so contentious an innovation, or we should hardly find him inviting several strong free traders to join his Cabinet. But we do not fear, either, that he will consent to sacrifice the present measure of Imperial Preference just to gratify free trade purists; and we are hopeful that if the Imperial Economic Conference to be held in the Autumn advocates an extension of such preference, he will give a sympathetic ear to its proposals. In the meantime the Government seems confirmed in power and, bar accidents such as arise from "snatch divisions" in the House of Commons, it should easily last out its term of office, which is the life of the present Parliament.

American Sugar Affairs.

The American Government did not succeed in its attack on the operations of the New York sugar exchange, the injunction asked for being refused by a Court of four Judges. But the proceedings appear nevertheless to have acted as a warning to the market in general, and to have discouraged further rigging of the market. The latter has been quiet in the extreme the last few weeks, most parties playing a waiting game, while the holders of sugar have been in no hurry to dispose of their stocks as they had good reason to believe that the international shortage of supplies would tell in their favour. The heavy consuming season for sugar in America is just beginning, and since invisible supplies are not believed

to be anywhere great, it may be assumed that the law of supply and demand will reassert itself on the trend of prices before the summer is far gone.

If the political agitation against the sugar market has failed, the proposed public boycott of sugar has been no more successful. The recent incidence of sugar prices in the States is probably summed up as accurately as anything in the following remark of an American newspaper: The speculators knowing the weakness of the American people, play upon their gullibility by announcing a probable shortage. Immediately the hoarders begin their purchases and the price is sky-rocketed. An opposing group, knowing it will profit by a bear movement against sugar, inaugurates a boycott and hysterical people flock to their standard with the result that the price drops temporarily.

The sugar trade of New York have however thought fit to send a letter to PRESIDENT HARDING, signed by practically all their members, protesting against the insinuation of Government officials that the sugar market was using unfair methods and working against the best interests of the general public. They gave him data to show that the rise in prices was due to the law of supply and demand, being governed by the undisputable fact that there is a shortage of sugar in the world in terms of the probable consumption.

Stability in the Queensland Sugar Industry.

Apropos of the oft repeated demand put forward by those interested in the sugar industry in Queensland for some degree of stability. it must be remembered that this industry differs radically from most other enterprises in tropical agriculture. It is necessary not only to produce the raw material on the spot, but to work up the expressed juice with the least possible delay, and to convert it into good dry sugar which can be safely stored under tropical conditions or can pass to its distant markets in the temperate zone, across the sea, without injury. For this purpose it is necessary to erect expensive machinery on a very large scale, and a great deal of capital must be raised and locked up to make it a paying proposition. Cotton, jute and other fibres, oil seeds, grains, tobacco, etc., can be planted without any anxiety beyond the success of the year's crop and may be omitted at any moment, if this is suggested by the state of the world's markets; while rubber, tea, coffee, cinchona and pepper, being perennials, may, at least to a large extent, be slowed down and the estates kept going till better times. But, once the factory is erected, it must carry on through good times and bad, or become a disastrous failure. It is a rare thing indeed that a sugar factory can be moved bodily and planting commenced elsewhere, and to sell it piecemeal is practically going into liquidation. A deserted cane mill is one of the most pitiful sights in tropical agriculture.

A study of the Queensland sugar industry presents the onlooker with a most striking example of the importance of this factor, stability. And it is particularly unfortunate that both the elements of nature and the apparently equally uncontrollable machinations of politicians appear to be arrayed against the cane farmer and miller. The weather appears to take a capricious delight in upsetting human calculations as to the amount of crop obtainable in any year, and the insect pests have assumed a threatening attitude on many occasions while, on the other hand, the price obtained for sugar bears little reference to that of the world's market, but is financially controlled by a large public belonging in the main to a country under different conditions. The "good old times" when the Colony of Queensland controlled its own affairs and employed the labour appro-

priate to the crop and climate are of course long since past. The Commonwealth, itself almost entirely outside the tropics, has ordained that Australian labour shall be white, and, further, that sugar must be cheap, although white labour is more costly in the fields than that in any other sugar growing country in the tropics. And thus, what with the unforeseen surprises of nature and the political tangle, it is a wonder that there is any cane sugar industry at all in Queensland. It all shows how wonderfully adapted for sugar cane growing is this fine country.

Three years ago the cane industry in Queensland nearly went out by a combination of its two chief enemies, climatic and political. But, at the last moment, wiser counsels prevailed and more favourable prices were granted for the sugar produced for a period of three years. How this brief steadying period has been utilized is referred to on another page in this issue, and it reflects great credit upon all concerned, whether cane farmer, miller, or the friend of both, the Director of the Bureau of Sugar Experiment Stations. During the first of these three years, little benefit accrued to the industry because of the severe drought; in the second year both the industry and the State reaped a full advantage and production at length overtook the Commonwealth consumption; the third year should have produced a record, but again the weather caused trouble, so that some 400,000 tons of canes were lost during the last lap of the growing period. Meantime the Government's attitude had not been altogether what those interested in the local sugar industry had hoped, and prospects were not particularly rosy in Queensland. But again the futility of prophecy has apparently been demonstrated, and the position has undergone a sudden change, this time in favour of the sugar planters and millers. How this has come about may be gathered from an article which we print by Mr. T. D. CHATAWAY, who appears to possess an intimate inside knowledge both of sugar matters in Queensland and the politics connected with it.

The Exotic Value of Coimbatore Seedlings.

In the last number of this Journal we drew attention to the somewhat remarkable results being obtained in India by certain new seedling canes raised in the Coimbatore Cane-Breeding Station. The outstanding features of these new seedlings appear to be general vigour in growth, large outturn of canes with rich juice, early maturity, depth of rooting and consequent capacity to withstand drought and, in others, a similar resistance to frost. It occurs to us that it is worth while emphasizing these features in order to draw the attention of those parts of the Empire which, being outside the tropics, have been driven to planting cane varieties of a similar nature and origin, notably Natal, Southern Queensland and New South Wales. It also appears possible that other countries such as Egypt and Argentina, which appear to be seeking salvation in growing Java crosses, with one parent a thin Indian cane, might find it advisable to make a trial of these new seedling canes. We have not yet received the results of the milling tests conducted on a crop scale, but are assured that they are surprisingly good; so that even if these cane varieties do not come up to the local standard they may be of use as a reserve which every country with a limited number of suitable varieties should have at hand in case of disasters—which unfortunately form a great part of the history of sugar cane cultivation. One point should also be borne in mind, and that is that these Coimbatore seedlings are merely the *first batch*, and were raised a number of years ago; and that since they were produced the station has been year by year bringing together the desired parents for the production of numerous other seedlings. We are indeed assured by the officer in

charge, Rao Sahib T. S. VENKATRAMAN, that he has a number of newer seedlings undergoing their trials which are in all respects superior to those already sent out. Once the way is opened for this class of work, there are many paths by which better results may be obtained, for instance by using the successful seedlings as parents and crossing them with other varieties with the object, so to speak, of inserting characters which the original seedlings do not possess in a marked degree, and doubtless this simple procedure has not been overlooked. But the reports of the work on the Coimbatore farm have been few and far between of late years, doubtless owing to the prevailing craze for economy which seems to be threatening the Indian Agricultural Department, small and defenceless as it is. We would, however, commend the paragraphs in last month's Notes and Comments to such countries as may be interested, promising to give such further details as they reach us of the actual analyses and yields obtained.

The Agricultural College in Trinidad.

According to the *West India Committee Circular*, the contract for the erection of the new buildings for the West Indian Agricultural College in Trinidad has been awarded to the well-known firm of Foster & Dicksee, Ltd., of Rugby, whose agent, Mr. G. D. BROUGH, has left for Port of Spain, with Mr. H. C. AMIES, the clerk of the works, who will represent the architect, Major HUBERT C. CORLETTE. It is understood that work will be begun on the site very shortly, and that unless anything unforeseen should occur to prevent it, the new buildings and research laboratories will be ready for occupation in October, 1924. In pursuance of the object of the Governing Body to make the college an Imperial asset, an appeal will shortly be issued by LORD MILNER for funds to enable the building scheme to be carried out in its entirety, and to provide for the nucleus of an endowment fund. We understand that the sum aimed at is £100,000.

It is proposed shortly to appoint a sugar technologist; and the Governing Body have now under consideration the question of the erection of the model sugar factory at an early date, so that advantage may be taken of the generous offer of British sugar machinery manufacturers to present apparatus and equipment to the value of at least £20,000. Another special feature of the college will be the research laboratories, where investigations will be carried out in connexion with all economic tropical plants, and it is understood that a successor to Mr. T. G. MASON, in the position of Professor of Botany has been selected, of whom much is expected.

Poland.

The Polish sugar industry developed in a most satisfactory manner during 1922 owing to the increased area of beet planted, which was 31·35 per cent. more than in 1921. There were 69 sugar factories in operation as compared with 67 in 1921 and 88 in 1913; the total production will be about 320,000 tons, as compared with 225,000 tons in the previous year, of which about 80,000 tons will be available for export, leaving 240,000 tons to supply the local *per capita* consumption of 18·7 lbs. The sugar exported has gone mostly to Great Britain.

We learn that Mr. FRANK P. RUDDER, M.I.Mech.E., advising engineer to Messrs. Henckell, Du Buisson & Co. (general managers of the St. Madeleine Sugar Company Ltd., the Antigua Sugar Company, Ltd., and the St. Kitts (Basseterre) Sugar Factory Company, Ltd.), has been unanimously elected by the St. Kitts planters to be their representative on the Board of Directors of the St. Kitts (Basseterre) Sugar Company, Ltd.

Fifty Years Ago.

From the "Sugar Cane," June, 1873.

In this number ALEX. S. WILSON disputed the validity of the method of determining water in animal charcoal, according to which this constituent was assumed to be equal to the loss of weight found on heating to 212° F. for several hours. Experiments were described showing that this method gives results much lower than the truth. In these tests the water was estimated directly by passing dry air over a weighed quantity of the sample contained in a platinum boat in a glass tube, heated to different temperatures, the air issuing from the tube being sent through a small calcium chloride absorption apparatus, which was weighed before and after the experiment. At 212° F. the water was found to be 4·73 per cent.; and at 350° F., 6·10; and other experiments conducted at a temperature considered insufficient to convert any hydrogen in the char into water gave a still higher result, namely, about 7·5 per cent. as the amount of water present. It was concluded from these results that "Mr. Patterson's 'organic matter' consists chiefly of water, which is not expelled at 212° F.," this being a reference to a paper which was noticed in our last number.[1] Determining the water in this way, he found that the result when added to the carbon was practically equal to the loss on ignition; whereas when the water was determined at 212° F. there was a difference between the two figures of about 3·5 per cent., this being assumed by PATTERSON to be organic matter.

A writer named ISAAC GREGORY, of the Merchants' College, Blackpool, attacked the semi-refined beet sugar which was being sold in this country at that time, stating that its sweetening power was much inferior to that of cane sugar, which opinion was also shared by the Editor of the *Sugar Cane*. In another paper the replies given to a questionnaire sent out by the Belgian Minister of Finance regarding the best method of analysing raw cane and beet sugars for the purpose of the assessment of duty were reproduced. One of the clearest responses was made by M. ANGENOT, of Antwerp, who advised the use of Soleil's saccharimeter or Wild's polaristrobometer for the estimation of the crystallizable sugar, and of Barreswil's, Fehling's, or Violette's standard solutions for the determination of the "glucose," which reagents were stated to possess "a remarkable delicacy." H. A. SMITH described the principle and construction of Biot's polariscope, in which the light was polarized by reflection from a black plate, movable to give the inclination necessary, the analyser being a double refracting achromatic prism. Some of the first results were recorded regarding the beet sugar industry of the United States, as obtained at the Alvarado (Cal.) factory, where the 1872 crop was about 500 tons, the average yield from the roots in sugar being about 8½ per cent. There was an article discussing the origin of the cane borer in Mauritius, and it was concluded that it had been introduced with a shipment of canes from Ceylon made in 1848, this fact demonstrating "how cautiously must be watched and controlled the importations of one country into another, since the ruin of a whole community may be brought about by one of the most despicable in the Almighty's creations."

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[1] *I.S.J.*, 1923, 234.

Tully Central Sugar Mill, Queensland.

Some Details of the Specification.

Tenders have lately been invited for the construction and erection at Tully, Queensland, of a new sugar central,[1] destined to crush 150,000 tons of cane in 25 weeks grinding, with 50 per cent. maceration and an average extraction of 96 per cent., the average fibre in cane being 10½ per cent. The production of raw sugar per week of six days is to be some 900 tons.

The mills are to consist of four independently driven 3-roller sets with rolls 35 in. × 72 in., driven by engines 24 in. × 48 in. through steel compound gearing. An all-steel cane carrier 72 in. wide with two chains and wooden slats, driven by an independent steam engine and served by four David type cane unloaders, will feed the cane to the mills. The latter are preceded by two sets of revolving knives and a cane shredder. The juice pumps are to be of the motor-driven geared plunger type, and mechanical juice strainers are to be supplied.

The four juice heaters are to be arranged in pairs, while three continuous cast-iron subsiders, 20 ft. diam., a clear juice tank of 5000 gallons, four scum subsiding tanks 8 ft. × 4 ft. × 4 ft., and eight filter-presses, each of 390 sq. ft. surface, are to be included. As an alternative the Thomas & Petree process can be quoted for.

The evaporating plant will consist of a quadruple effect evaporator, having 20,000 sq. ft. of heating surface, on staging 12 ft. high; and two cast-iron vacuum pans of the calandria type, 12 ft. diam. with 1200 sq. ft. heating surface, as well as a third pan of the coil type with 1100 sq. ft. heating surface. Each pan is to have a separate Torricellian condenser with independent multiple air-pumps, preferably of the Edwards type and motor driven, though other types are not excluded. The evaporator will also have a separate condenser and air-pump, and all air-pumps will be interchangeable.

Eight enclosed crystallizers, 7 ft. 3 in. dia. × 26 ft. long, will be supplied, and the centrifugal mixers are to be large enough to hold the contents of one crystallizer. The centrifugal station will consist of eight self-discharging machines for first sugar, having bronze baskets 42 in. × 24 in., solid spindles, and ball bearings, direct driven by electric motors taking alternating current of 3-phase, 50-cycle, 415 volts. For the second sugars eight hand bottom discharging centrifugals with baskets 42 in. × 20 in., also direct electrically driven, will be required. But in either case the specification allows for 40 in. machines to be quoted for.

An all-steel sugar elevator for first and second sugars is to be provided, that for the first sugars to be capable of delivering to a sugar dryer at the rate of 15 tons per hour, while that for the second sugars will deliver on to a sugar floor or into a magma mixer of 4000 gallons capacity.

The subsequent equipment includes automatic filling and weighing machines, bag sewing machines for 170 lbs. bags, and two electric stacking hoists.

The boilers are to be of the water-tube type, to evaporate 86,000 lbs. of water per hour, at a pressure of 145 lbs. These are to be fitted with superheaters and Green's economizers; and two of the units are to be installed for either coal or bagasse firing. The feed pumps will be Weir's, and continuous recorders for high and low pressure steam and CO_2 are to be supplied. An all-steel bagasse elevator and conveyors from mills to furnaces will be included in the equipment.

[1] See *I.S.J.*, 1923, 264.

The electric generators will be either driven by compound high speed engines or else steam turbines. Either three sets of 350 k.w. each, or four sets of 250 k.w. each will be installed, the current being alternating, 415 volts, 3-phase, 50 cycle; these generators will be of the revolving field type with direct connected exciters and be able to take a 25 per cent. overload for two hours. All motors over 6 h.p. are to be of the slip ring type. The electric lighting will be served by two single phase transformers of 12 K.V.A. each.

New Beet Sugar Factories in England.

Conditions for financing New Schemes.

The British Sugar Beet Growers' Society Ltd., which, as is well-known is a purely propagandist organization, has lately issued a statement in which it points out that while it is itself unable to provide and work any new sugar factories in this country, it undertakes to introduce to interested parties such persons or organizations as might be willing to assist in financing sugar factories and who have at their disposal the necessary technical qualifications and expert personnel. Under this plan the promoters of any factory scheme in a suitable district, can (1) be placed in touch with financial assistance that would provide half the capital on terms to be arranged; (2) be provided with an expert technical personnel to supervise and direct the English labour; and (3) be relieved of full responsibility for the manufacturing operations during the initial years of the scheme. The number of such schemes to be assisted would of course be limited at the outset.

The offer is, however, subject to the following conditions based upon current experience in this country as well as abroad:—

(1) The factory shall have a capacity of 1000 to 1200 tons of beet per day so as to obtain a certain average through-put of 800 to 1000 tons per day during the manufacturing season in the Autumn—October 1st until Christmas.

(2) The factory site shall be in a central position with an ample supply of water (about 3000 galls. a minute), with labour readily available (600 to 800 men during the manufacturing season) and with good facilities for transport by rail and road and water.

(3) The district surrounding the factory shall allow for 30,000 acres of arable land suitable for the beet crop within a radius of 20/30 miles; that is to say, up to 10,000 acres per annum in rotation.

(4) The beet contract shall be identical in terms with that offered to Farmers by the Kelham and Cantley Factories, the price being based upon the average sale price of sugar manufactured and the average sugar content in the beets supplied.

(5) A minimum acreage of beet of 5000 acres for the first manufacturing season shall be guaranteed.

(6) As the success of the factory depends upon the technical skill and experience applied to the manufacture of sugar by the technical experts, the management of the factory shall be under their control, and the plans and specifications of the factory shall be approved by them.

(7) The capital shall be £400,000 to £500,000, this being the requirement for such a factory equipped on modern lines under present conditions of the market for materials and labour, £80,000 to £100,000 of this sum being necessary for Working Capital and Reserve Balances.

(8) The promoters shall raise half the Capital locally, preferably from the growers of sugar beet themselves.

Sugar Cane Experiments in Queensland.

The Annual Report of H. T, EASTERBY, the Director of the Bureau of Sugar Experiment Stations in Queensland, for the year ending 31st October, 1922, is, as usual, full of interest. It deals with the experiments made and the crops taken in 1921, the second of the three seasons during which the favourable agreement as to the price of sugar was running its course, and describes a prosperous harvest both for grower and miller. The first season showed little advantage over the previous one, both of them being spoiled by drought, but the 1921 harvest produced 114,797 more tons of sugar than in 1920, and production thus easily overtook consumption, one of the results hoped for when the agreement was entered into. This great achievement was of course primarily due to favourable weather following the previous years of drought, but was also due to the feeling of security given by the knowledge that a reasonable price would be obtained for any sugar produced. Farmers were able to lay out money on manures and better implements, new rich lands were brought under cultivation, and others that had temporarily gone out were again taken in hand; and the millers were also encouraged to overhaul their machinery and greatly increase the output and efficiency of their factories. But it is obvious that, while political action can do so much for the success of the industry, the weather is uncontrollable, and this fact should not be lost sight of in considering the price to be received for the sugar produced.

Reviewing the last few years' results we note that the climatic factor appears to be specially unreliable in all parts of Queensland, as compared with other sugar cane growing countries; and no one can with any degree of certainty prophesy what kind of crop will be reaped until close on the harvesting season. This uncertainty has been well exemplified in the season of 1922 also under report, for by the disappointing character of the later part of the growing period the tonnage estimated in May at 2,572,000 was reduced in the forecast made in October by no less than 400,000 tons of canes. We have almost become accustomed to the news of dramatic deluges, droughts and frosts in the Queensland sugar tract, but these have been markedly absent during the year, and yet the result appears to be the same. Let us take as an example the weather report sent in from the northern moister region, where the total rainfall for the year was 135·86 in., no bad amount for sugar cultivation. We read that "the weather was on the whole unfavourable for the growth of the crop and the rainfall was spasmodic and uneven and was followed by early cold snaps." During the period between September and November, the canes had little vitality; good rains fell between December 18th and January 3rd, but then for a month only 1·65 in. were recorded. Again, from February 6th to the middle of March, there were good rains, which caused the canes to recover and placed them in a good growing condition, although of course still backward. From the middle of March until early April the weather was sufficiently cold to check growth, but good rains were experienced from the middle of April into May with a higher temperature, so that again things looked more promising; but unfortunately the winter set in exceptionally early, the final result of the ding dong changes being a greatly diminished tonnage although the juice worked out as of good density. Such variations and exceptional conditions fully account for the discrepant estimates of the crop mentioned above. With such a long drawn out tract, there is always a chance that unfavourable conditions in the north may be countered by better weather in the south, but this was not the case in 1922; and, although the weather reports from the three chief centres were by no means coincident, in all of them some untoward features presented themselves. The net result of this has been that in the third year of the agree-

ment, the absolute record freely expected is not likely to be realized. The lot of the planter in Queensland is not an easy one, and anxiety in one form or another, whether because of the political situation or the weather prospects, seems to be bound up with the industry.

The Bureau is now 22 years old: it started with one experimental station at Mackay and a chemical laboratory at Bundaberg, and now there are three stations, at Mackay, Bundaberg and South Johnstone, and an entomological laboratory at Meringa. Two field assistants and the Director were constantly touring, and reports have been sent in from 2839 farms. Of these 277 went in for liming, 579 for green manuring and 597 applied chemical fertilizers, the latter practice greatly increasing during recent years. The Director gives as usual a detailed review of the various districts, and divides them as follows:—Mossman (1 mill), Cairns (3), Innisfail (3), Herbert River (2), Lower Burdekin (4), Proserpine (1), Mackay (8), Bundaberg and Gin Gin (5), Isis (3), Maryborough and Piabli (1), Mount Bauple (1), Nambour (1), Beenleigh (5). Numerous farmers' meetings were held all over the country and were well attended, and several field days were held with great success.

South Johnstone Station.—The manurial experiments in this newly-founded station are getting into their stride. Holbourne Island phosphate (with 17 per cent. P_2O_5 + 10 per cent. $CaCO_3$), superphosphate, sulphate of ammonia, nitrate of soda, sulphate of ammonia + super, and Holbourne Island phosphate + sulphate of ammonia were applied in different plots, with a no-manure plot between each two. In judging the results each plot was compared with the mean of the two no-manure plots adjoining it. This is the third time this experiment has been judged, first as plant canes, and then as 1st and now as 2nd ratoons: the conclusion is very favourable to the first two manures, while the rest have given little or no advantage over no manure. This anomalous result is regarded as being due to the comparative solubility of the bulk of the manures, the great rainfall of the district leaching them out before their influence can be felt. Of various methods of treating the ratoons over the same three crops, that recommended by the station has been most successful, namely, burning the trash, and cultivating the interspaces by ploughing four furrows and subsoiling each. Subsoiling of itself for plant canes was judged in 1920 to be of little use, and this was in accordance with the opinion of the local farmers; but in 1921 with the same canes as 1st ratoons it showed to some advantage, and this is regarded as being due to the year being one of deficient rainfall. Of the different varieties tested as plant canes in the previous year and 1st ratoons in 1921, B 6540 and M 55/1182 gave the best results: all the Queensland seedlings tried gave good weight of canes, but Q 813 and Q 812A gave far superior juice densities to the others, besides being early maturing varieties: of the Hawaii seedlings tried, H 109 was the best.

Mackay Station.—The rainfall was below the average, 50·42 in. having fallen instead of 68·54 in., the average of 23 years. The subsoiling experiment was brought to a conclusion, having now passed through the plant canes, 1st and 2nd ratoons, with the following results per acre as against the ordinary cultivation.

Plant canes (17 months):	37·1	: 28·5	tons cane, and	5·15	:	3·85	tons sugar.
1st ratoons (12 months):	35·8	: 29·9	do. , and	5·35	:	4·48	do.
2nd ratoons (11 months):	27·7	: 22·1	do. , and	4·29	:	3·45	do.
Total three crops	: 100·6	: 80·5	do. , and	14·79	:	11·78	do.

This shows clearly the advantages of subsoiling lands with clayey subsoil, providing the latter is merely stirred and not inverted and thus brought to the top.

In regard to the commercial value of certain varieties, including eight Queensland seedlings, and two canes each from Fiji, Barbados and Demerara, Fiji 7 B 428 (Pompey) headed the list for plant cane and first ratoons, in tons of cane and of sugar per acre, while the other Fiji cane 8 B 431 was easily last: the average of the Demerara and Queensland seedlings was about the same, but that of the two Barbados varieties was somewhat lower. Renewed experiments with KCl and K_2SO_4, showed that the former had no deleterious effects on the cane juice, both in plant canes in the previous year and first ratoons in 1921. Competitive trials of 13 recently introduced new varieties (Hawaii three, Java five, and one Indian), compared with Q 813 and Green Gorru, in plant canes (17 mos) gave interesting results. E.K. 2 was well ahead in tonnage with 60 tons of cane, but was beaten in its tonnage of sugar (6·65) by E.K. 28 which gave only 48·5 tons cane but 7·67 tons of sugar. J 247 occupied third and fourth positions in these respects, Q 813 was fourth and second (7·35 tons of sugar). Shahjahanpur 10 was sixth and fifth, with 43·5 tons of cane and 6·18 of tons sugar.

Bundaberg Station.—The rainfall was fairly satisfactory and the winter was fairly mild, but hot winds set in from February to May and gave the canes a set back. The experiments are summarized under 13 separate heads, and perhaps the following results are the most interesting. The experiment of growing canes on land which had borne lucerne for many years was carried through to second ratoons and gave the same result that had been obtained in previous years with plant canes and first ratoons, namely that the prejudice against such land for cane planting was unfounded. Liming the land with different forms of this substance were without reward in first ratoons, as with plant canes in the previous year: and the same may be said of the experiment with from 1 to 6 tons per acre, which was started because it seemed possible that the amount applied had been insufficient. Subsoiling again in first ratoons appeared to be disadvantageous for this tract, the non-subsoiled plots giving the better returns as they had done in plant canes. As regards the part of the plant taken for planting the uppermost 3-eyed sets gave the best results in first ratoons: in the previous year the lowest butt end gave the best result in the plant canes, but this advantage was apparently lost in the 1921 first ratoons. A comparison between taking plant material from plant canes, and first to third ratoons gave the same result as in the previous year, namely that third ratoon sets could be quite well used. An experiment in spacing the sets in the row, from being continuous to 36 in. apart, showed that the closer planting gave the highest out-turn. In the experiment with introduced varieties (Java five, Hawaii two, and one each Mauritius, Demerara and India), stand over crops of 22 months, E.K. 1 and E.K. 2 led, and were well away from the rest.

The arrowing of the canes on the three stations was as usual carefully noted, and the results may be compared, especially as they agree so well with those in India. In tropical South Johnstone 58 varieties flowered from 13th May till 23rd June: at Mackay further south 14 varieties were noted as flowering from 7th June to 14th August, while we do not meet with any reference to the cane flowering at Bundaberg which is outside the tropics. The average yield of canes in tons per acre in the three stations was 31·11, 21·25 and 16·74 respectively. The rainfalls recorded (September 1921 to August 1922) were, in inches: 135·86 (considered short), 50·42 (average 68·54), and 46·81 (apparently considered normal). The extent south to north of the sugar belt in Queensland and New South Wales is, we should say, approximately the same as that in India; but, because of superior geographical position, the conditions are on the whole considerably more favourable in this part of Australia than in India, for the growth of tropical varieties.

C.A.B.

The Australian Sugar Industry and Its Prospects.

Government Control Withdrawn.

By T. D. CHATAWAY.

It is a peculiar fact that at the very moment a section of those engaged in the sugar industry, and chiefly allied with the Labour policy of Queensland, were ignoring the results of the general elections and persistently demanding a renewal of the sugar agreement of 1920-23, conditions were arising which made all their fuming more than ordinarily futile. The more serious-minded (that is less political) of those connected with the sugar industry were seeking a way out of what threatened to be a very dangerous position. Parliament had accorded but half-hearted support to a strong protective duty, permitting Java whites (mill-washed) to come into the country at the same rate of duty as raws, and in addition it was anticipated that at the end of the coming June, when the Government control expired, there would be a surplus in Australia of some 60,000 tons. The prospect was, therefore, that the home market for Australian sugar would be swamped not only with its own supplies but also with cheap plantation whites from Java. It was suggested as a way out of the probable difficulty that the supplies of Australian sugar be pooled, and that, subject to certain reductions in prices, the Commonwealth Government should exercise its right and place an embargo upon the "dumping" of sugar from coloured labour countries. The new Government declined to entertain this proposal, and the sugar people were still considering how best they might carry out their own ideas, even without the good-will of the Government, when the position was completely altered by two factors, one the rapid rise in the price of sugar abroad, owing to the fact that consumption last year exceeded output by some 750,000 tons, and two, the prolonged dry weather in Australia, especially during the wet season in the sugar districts, which makes it even doubtful whether during the next twelve months, despite the carry-over of 60,000 tons, Australia will not have to import from abroad.

The irony of the position is obvious to those taking an intelligent interest, but the fruit-growers, housewives' associations, *et hoc genus omne* have been so imbued with the teachings of the jam-makers and free-traders that they are still demanding that they should be allowed to buy sugar from abroad and bring it in duty-free, despite the fact that it is at this moment quite certain that if there were no domestic sugar industry and no import duty they would be paying at least a halfpenny a lb. more for unrefined sugar than they now pay for refined. The jam manufacturers are discreetly silent. They are receiving £14 rebate at this end and £4 5s. 6d. a ton rebate on the sugar contained in the jams and preserves imported into the United Kingdom. Thus they pay £42 in Australia and receive back £18 5s. 6d., the net cost of their sugar, therefore, being £23 14s. 6d. a ton. New Zealand is paying £30 a ton for Java whites, and the jam manufacturers have now discovered that unless refined these whites do not suit the quality of their products. The Australian sugar producers are consequently not looking forward to a slump in their home market, and the whole problem of a few months ago has practically solved itself for the time being.

The season, which ended four months ago, proved itself almost a replica of the previous one. The figures for the past three seasons may be compared as follows:—

	Area Cultivated. Acres.	Area Harvested. Acres.	Sugar Produced. Tons.
1920	162,619	89,096	167,401
1921	184,513	122,782	282,198
1922	209,300	149,863	288,928

	Cane per Acre. Tons.		Sugar per Acre. Tons.		Cane per Ton Sugar. Tons.
1920	15·03	....	1·88	....	8·00
1921..	18·60	....	2·30	....	8·10
1922	14·52	....	1·92	....	7·53

In each year, under the agreement with the Commonwealth Government, the price of raw sugar at the nearest port to manufacture was £30 6s. 8d. a ton for 94 per cent. net titre, and the average price paid for cane to the growers was £2 10s. a ton. The harvesting season which should commence about the middle and end of June, according to latitude, is now not likely to start till much later. There has been an entire absence of the usual monsoons, and now (the middle of April) it seems impossible to hope for a recovery sufficient even to approach last year's output. Indeed if the total production of Queensland and New South Wales reaches 250,000 tons of 94 per cent. sugar, the result will exceed official expectations. With the carry-over of 60,000 tons this will not leave any considerable stocks at the end of June, 1924, and none at all if the markets abroad continue at their present level. The Australian industry thus gets a little more of the breathing time it requires to reconstruct after the war.

Reconstruction and reorganization cannot be accomplished in a moment. At present it is taking two forms in regard to the Australian industry. The farms or plantations are still being made smaller and the mills larger. There were last year 4500 farms, all growing cane, with an average under cultivation of 46 acres. There are, however, especially in the Southern districts, many farms where as little as five acres is cultivated, while in the Northern districts the average cultivation is 56 acres, and there are some few farms which grow several hundred acres. But with the tendency to lessen the size of the farms, and so reduce the labour problem, there persists the difficulty, mentioned by me some three years ago in this Journal, of scientific and mechanical progress. This is being overcome by vicarious methods. The Government of Queensland has control of a number of sugar experiment stations, and attached to these are field-assistants who are constantly moving from farm to farm, assisting farmers with advice, making observations, and reporting upon the methods of work. The last report of the Director or Superintendent of these stations records receiving reports in respect of no fewer than 2839 farms, and we are told the number of farmers who use lime, green manure, and other fertilizers. It may be noticed that so far the reports of the field assistants cover nearly two-thirds of the total farms, and the system is still in its infancy. In the future the disadvantages previously noted of the very small farm system may be overcome in this way.

The matter of using mechanical appliances in the fields has undoubtedly been greatly hampered by the stupidity (one can call it nothing less) of the Commonwealth Government. It knows that petrol is scarce and expensive, and stands in the way of the general adoption of motor implements in the fields. It has also been told over and over again that some 8,000,000 gallons of molasses, capable of producing motor fuel for the whole of the sugar districts, at present goes to economic waste. The answer of its officials has ever been that it is necessary to use certain denaturants, and nothing will move them. They fear lest by some oblique method the power alcohol, cheaply denaturated, will be redistilled and converted into potable spirits. This attitude cannot be persisted in, and there is reason to think that a saner view is now about to be taken. In the more Northern districts the employment of tractors and implements driven by internal combustion engines is rapidly increasing. The *Australian Sugar Journal* editorially states, for instance, that hand-planting of cane has become the exception, and that where tractors are

employed two men can perform the whole operation of drilling, planting and covering at the rate of four acres per day. In many cases also farmers owning tractors or mechanical implements meet the requirements of the men on small areas by doing the work for them by contract. The day when motor spirit is supplied to all the farmers in the neighbourhood of a mill is not far away, though there is reason to believe that the ambitious project of a large distillery in the Mackay district, to which I made reference a few weeks ago, has not as yet materialized.

On the factory side many improvements were made last year, and several mills were rendered capable of still further increasing their annual out-turn. In the most northern districts there are now nine mills, with capacities varying from 10,000 tons of sugar a year to 16,000, and last season they produced an average of over 10,000 tons apiece. In the central and southern districts, of the 24 mills there are only nine with a capacity of 10,000 tons and over, and only five mills actually turned out ten thousand tons or more last year. The policy, with one exception to which I shall presently refer, is not to increase the number of mills but to add to their capacity, and where that considerably exceeds their normal output to increase the supplies of raw material by extending tramways and railways into new cane-growing areas. Roughly, the milling capacity is now 360,000 tons, and the out-turn 290,000. There is no single mill working up to its full capacity, and therefore it is additional supplies rather than power which is sought after. The sole exception is in the case of the Tully river country between Mourilyan (Johnstone river) and Ingham (Herbert river) on the 18th parallel of south latitude. A royal commission has investigated this country and reported that there is an area of 4000 acres of good cane land, and 11,250 of fair to third class cane land. In addition, there are some 7000 acres of good cane land which might be tapped by tramways, if it becomes necessary. The report recommends that a mill be erected here, and in a recent speech the State Premier stated definitely that if his Goverment is returned to power at the elections it will proceed with the work. The mill would be erected on the same terms as Babinda and South Johnstone, the Government being in complete control. There is no question that should the present or any Government definitely decide to build the mill, the lands will at once be occupied by farmers, and planted with cane, with the result that by the time the mill is in operation it will have sufficient raw material to produce up to 15,000 tons of sugar. On a previous occasion I referred to the fact that in some districts where there are already mills, the royal commission was informed that no new mills were required, and I am informed by a leading Government official that should the Tully mill be erected, it is not likely that any other new mills would be required, as there are not sufficient cane lands concentrated in any one locality to make the erection of yet another mill economically sound. In future, therefore, the policy will be to continue to increase the capacity of existing mills, and to draw supplies from further afield than at present.

There are seven mills controlled by the State Government, Babinda and South Johnstone, each costing with tramways about £500,000, and five smaller mills originally erected by co-operative companies of farmers with money borrowed from the Government. These companies having got hopelessly behind in their payments, the Government has foreclosed and is now controlling the works, with the exception of MOSSMAN, which though indebted is still under local control. All the accounts are kept on the same basis, and provide for interest, depreciation, maintenance, repairs and off-season expenses, nor is there a very great deal of

difference in the actual cost of producing a ton of sugar. The quantity of output tells the tale, as may be seen by the following small table :—

	Output. Tons.	Cost per ton Sugar. £	s.	d.	Profits. £
Babinda	11,684	29	12	4	15,577
Gin Gin	3,457	28	9	1	8,461
Mossman	8,000	30	5	8	5,108
Mount Bauple..	2,897	29	8	6	3,833
North Eton	5,766	29	10	9	5,907
Proserpine	7,575	29	0	4	11,639
South Johnstone.. ..	12,269	29	8	5	17,133

These figures, it is true, are for 1921, but they equally apply to the season just past, where the outputs were almost identical and the price received for sugar the same.

It is only right to say that the foregoing figures by no means profess to represent the best that the large sugar mills can do, but there are strong objections to making the figures of costs known to the public, owing to political misrepresentations. Further many of the sugar companies pay the farmers better prices for their cane than do the mills under Government control. That it is felt that the costs are now too high may be gathered from the fact that at a meeting some months ago in Brisbane of sugar representatives, when the idea of a pool was mooted, it was agreed that the cost of sugar to the pool should be based upon raw sugar at £27 a ton instead of the present £30 6s. 8d. Of course the chief source of economy is the persistent determination to work the mills up to their fullest capacity, but other forms of economy are not being overlooked. The port of Cairns which at present handles some 45,000 tons of sugar a year—all by hand—has finalized its schemes for mechanically doing the work, while the reduction of 2s. 6d. a ton in shipping freights is probably only a prelude to further reductions. I noted at one time, when a big surplus looked probable, that it was suggested that the Commonwealth steamers should call at Queensland sugar ports and take sugar direct to New Zealand and other places, and thus avoid the expensive business of taking it to the southern refineries in Australia. The idea may yet take form when the necessity arises. The present set-back is unfortunate. The continued dry weather has not only spoilt the crop for the present year, but it is likely to seriously affect the early planting for next year. Young cane in some of the southern districts is turning yellow for want of moisture, and it is only north of Townsville that even moderately satisfactory weather has been experienced. But the white man in the Australian agricultural tropics is making steady progress, and is not at all likely to be disheartened by the ill-luck just now attending him.

Concerning the white man in the tropics it may be worth while to mention the details lately published by the Bureau of Census and Statistics, based upon the particulars gathered at the census in April, 1921. They form a very complete reply to those who argue that either the coloured man is crowding into Queensland, or that the Europeans in the sugar districts are highly undesirable Europeans. In the first place it is shown that less than 2 per cent. of the whole Queensland population of 755,972 are coloured men or half-castes, and further that of the latter the great majority are half-caste aboriginals. Of the full-blooded coloured population there has been a falling off of 2227 since the census of 1911, and the total number in the State at the last census was only 9109. So much for the coloured men. Of the undesirable Europeans we find there has been a decrease in all except Italians, Greeks and Russians, and the total increase of all European

nationalities, except British, during the ten years, has been 267. Those coming from the British Isles, however, have increased by 7654, while Australians, New Zealanders, and a few officials in mandated and other territories (counted in with Queensland) show an increase of 146,176. Doubtless included amongst those described as Australians are the decendants of men of foreign nationalities, who have been born in this country. The general result of the census is, however, reassuring and answers the doubts which have been freely voiced as to the genuineness of the Anglo-Saxon settlement along the Queensland coastline, where alone tropical agriculture is carried on in Australia.

The 1922 Java Sugar Crop.

By H. C. PRINSEN GEERLIGS, Ph.D.

During 1922 182 sugar factories were in operation in Java, of which one, that of Sendang Pitoe, worked for the first time. The cane of Ranoepakis was worked up at Djatiroto, while that of Sedayoe was crushed in the Rewoeloe mill, so that the number of active factories was one less than in 1921.

The sugar estates had planted an area of 160,908 hectares or 397,443 acres, which was again slightly more than in 1921. The plantings did not however come up to the acreage of 1918, which has been the largest hitherto in any year in Java.

The total amount of cane reaped from that area was 16,759,106 tons, equivalent to an average of 42·05 long tons to the acre. The total output of sugar amounted to 1,779,557 tons, equivalent to 9950 lbs. to the acre.

We have calculated the figures for the different residencies and the totals and averages in tons, lbs., acres, etc., after the data given[1] by Mr. J. VAN HARREVELD in *Archief voor de Suikerindustrie in Nederlandsch Indië.*

The crop of 1922 proved a very good one; at the outset expectations were not so very bright, but, as the season advanced, it appeared that both tonnage and sugar content were maintaining an increase, which was shown by the fact that estimates had to be raised every month.

The weight of cane per acre was 42·05 tons, or only very little under the record year of 1917. The residency of Banjoemas was foremost this time with an average of 45·90 tons and its neighbour Kedoe last with only 35·12 tons per acre to its credit.

The sugar content of the cane was pretty good, inasmuch as 100 parts yielded 10·61 parts of sugar, which is a satisfactory figure, though not nearly so good as in the previous season.

The highest average rendement was reported from Kedoe, which therefore makes up for the low weight of cane, while the lowest average was to be found in Besoeki with only 9·67 per cent.

The highest yield of sugar to the acre is reported from the residency of Djokdjakarta with 10,951 lbs., while Semarang and Madioen follow closely with 10,643 lbs. each. The residency of Pasoeroean showed the smallest return, viz., 9023 lbs. only.

The maximum figure for one single factory occurred in Djokdjakarta with 14,480 lbs. of sugar to the acre and, just as in 1921, it is again the factory of Gondang Lipoeroe where this fine crop has been harvested.

The list of cane varieties does not show any marked difference as compared with last year. The once famous Cheribon cane has entirely disappeared from

[1] 1923, No. 10 and 11.

The 1922 Java Sugar Crop.

I.—Cane Crop.

Residencies and Totals.	Number of Factories in Operation.	Land under Cane. Hectares.	Acres.	Cane Harvested. Tons.	Tons per acre.	Kilograms per hectare.
Cheribon	12	9,497	23,458	929,670	39.66	99,464
Pekalongan	18	17,175	42,422	1,789,674	42.15	105,816
Banjoemas	6	4,976	12,291	564,658	45.90	115,214
Kedoe	2	3,1018	8,591	301,835	35.12	88,151
Djokdjakarta	17	15,944	39,372	1,681,368	42.67	107,122
Soerakarta	15	13,658	33,695	1,395,812	41.34	103,815
Semarang	12	9,748	24,067	1,089,406	45.20	113,474
Madioen	6	6,628	16,371	728,938	44.51	111,734
Kediri	21	22,337	55,172	2,371,092	42.95	107,818
Soerabaja	36	27,208	67,263	2,862,736	42.57	106,861
Pasoeroean	28	23,753	58,672	2,352,264	40.07	100,595
Besoeki	9	6,506	16,069	691,713	43.02	107,992
Total, 1922	**182**	**160,908**	**397,443**	**16,759,106**	**42.05**	**105,816**
1921	183	159,474	394,060	14,939,679	37.89	95,125
1920	183	156,069	385,647	14,398,238	37.34	93,732
1919	179	137,655	340,138	13,075,128	38.10	96,517
1918	186	163,071	402,943	15,637,342	38.44	97,387
1917	185	160,439	396,440	17,079,303	43.09	108,179
1916	186	155,165	385,290	15,878,300	41.11	103,218
1915	186	151,165	373,500	14,189,000	37.97	96,385
1914	186	147,465	366,000	14,901,000	40.87	102,009
1913	190	145,321	359,200	14,951,000	41.63	104,534

Tons of 2240 lbs.

II.—Sugar Extracted.

Residencies and Averages.	Kilograms per hectare.	Lbs. per acre.	On 100 Cane.	Yearly maximum output of any single factory. Kilograms per hectare.	Lbs. per acre.
Cheribon	10,790	9,563	10.83	11,662	10,336
Pekalongan	11,226	9,950	10.61	14,360	12,727
Banjoemas	11,835	10,488	10.27	14,231	12,613
Kedoe	11,313	10,026	12.83	11,446	10,145
Djokdjakarta	12,357	10,951	11.54	16,362	14,480
Soerakarta	11,748	10,412	11.32	15,101	13,384
Semarang	12,009	10,643	10.58	14,753	13,076
Madioen	12,009	10,643	10.75	13,838	12,265
Kediri	11,400	10,103	10.57	13,751	12,187
Soerabaja	10,878	9,641	10.18	14,012	12,419
Pasoeroean	10,181	9,023	10.12	13,316	11,802
Besoeki	10,442	9,255	9.67	13,142	11,648
Average, 1922	**11,226**	**9,950**	**10.61**	**16,362**	**14,480**
„ 1921	10,517	9,321	11.04	17,911	15,875
„ 1920	9,892	8,826	10.55	15,178	13,540
„ 1919	9,706	8,657	10.06	14,639	12,957
„ 1918	10,904	9,723	11.19	15,996	14,265
„ 1917	11,382	10,117	10.50	16,415	14,696
„ 1916	10,355	9,238	10.03	15,300	13,650
„ 1915	8,729	7,788	9.15	12,941	11,546
„ 1914	9,526	8,495	9.28	14,125	12,602
„ 1913	10,087	9,110	9.65	14,708	13,122

III.—SUGAR PRODUCTION IN TONS.

Residencies and Totals.	First Sugars.	After Products.	Total Production: After products as 4 : 3	Solidified Molasses.
Cheribon	97,226	4,535	100,628	402
Pekalongan	187,199	4,080	190,259	14,607
Banjoemas	57,924	43	57,957	—
Kedoe	38,738	—	38,738	2,965
Djokdjakarta	192,409	1,723	193,701	—
Soerakarta	155,647	3,196	158,044	—
Semarang	113,826	1,841	115,207	4,337
Madioen	78,137	657	78,655	2,798
Kediri	245,021	6,967	250,446	8,147
Soerabaja	287,238	5,940	291,693	19,509
Pasoeroean	230,517	9,271	237,480	5,051
Besoeki	65,747	1,336	66,749	4,309
Total, 1922	**1,749,649**	**39,609**	**1,779,557**	**62,125**
„ 1921	1,632,067	34,620	1,658,032	74,892
„ 1920	1,497,244	30,060	1,519,562	164,459
„ 1919	1,297,320	23,977	1,315,158	96,303
„ 1918	1,714,833	101,992	1,750,197	18,511
„ 1917	1,779,654	22,682	1,793,415	49,870
„ 1916	1,579,670	32,300	1,604,154	85,749
„ 1915	1,273,190	35,312	1,298,307	127,543
„ 1914	1,305,246	100,061	1,382,825	94,765
„ 1913	1,381,673	125,002	1,442,884	65,756

Tons of 2240 lbs.

IV.—SUBDIVISION OF THE CROP IN PERCENTAGES ACCORDING TO ASSORTMENTS.

Residencies and Averages.	White Plantation Sugar First running.	White Plantation Sugar Second running.	Channel Assortment Refining Crystals, 98° pol.	Refining Crystals, 96.5° pol.	After products.	Total.
Cheribon	48.4	4.1	20.3	24.1	3.1	100
Pekalongan	65.7	4.2	13.7	14.7	1.7	100
Banjoemas	—	—	63.6	36.3	0.1	100
Kedoe	—	—	58.3	41.7	—	100
Djokdjakarta	73.5	0.9	20.7	3.2	1.7	100
Soerakarta	84.3	1.5	12.2	—	2.0	100
Semarang	46.5	2.3	26.0	24.2	1.0	100
Madioen	82.4	—	16.5	—	1.1	100
Kediri	58.6	—	26.0	13.2	2.2	100
Soerabaja	60.5	1.9	23.3	12.6	1.7	100
Pasoeroean	20.6	—	43.0	32.7	3.7	100
Besoeki	—	—	65.6	32.7	1.7	100
Average, 1922	**52.85**	**1.53**	**27.45**	**16.46**	**1.71**	**100**
„ 1921	53.42	0.12	28.05	15.33	3.08	100
„ 1920	51.71	0.83	30.41	15.08	1.97	100
„ 1919	49.7	2.1	23.1	23.3	1.8	100
„ 1918	45.9	3.2	27.0	21.0	2.9	100
„ 1917	50.3	1.9	40.6	6.2	1.0	100
„ 1916	48.1	2.9	37.3	9.7	2.9	100
„ 1915	43.8	4.2	34.9	14.1	3.0	100
„ 1914	40.3	4.0	32.3	15.7	7.7	100
„ 1913	32.9	6.8	30.0	20.9	9.4	100

V.—Percentual Composition of the Cane Plantings of—

Variety.	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
B. 247	54	58	57	54	48	41	29	26	20½	17¼
P.O.J. 100	32	29	30	30	31	28	16	10	6½	4
Cheribon	8	6	5	5	4	3	1	1	½	—
P.O.J. 213	1	1	1	1	1	1	—	—	½	—
E.K. 2	—	1	1	2	4	4	6	6	6½	6½
E.K. 28	—	—	—	—	2	6	23	32	39	39
F. 90	—	—	—	1	2	4	4	3	3	3¼
D.I. 52	—	—	—	—	1	4	13	14	15	18½
Tjep. 24	—	—	—	—	—	2	1	1	1	—
S.W. 3	—	—	—	—	—	1	1	2	2	2½
P.O.J. 2714	—	—	—	—	—	—	—	—	—	2
P.O.J. 2725	—	—	—	—	—	—	—	—	—	1½
Various	5	5	6	7	7	6	6	5	5½	5½
Total	100	100	100	100	100	100	100	100	100	100

VI.—Factory Results during the Last Decade.

	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
Cane—										
Sucrose	12.54	11.91	11.63	12.42	12.82	13.63	12.38	12.94	13.41	12.87
Fibre	12.40	12.61	13.26	13.14	13.02	12.99	13.01	12.98	12.98	13.19
Bagasse—										
Sucrose	4.45	4.21	4.11	4.00	4.10	4.34	4.03	4.07	4.12	3.85
Moisture	46.52	46.27	46.64	46.97	46.82	47.22	47.01	46.76	46.43	46.30
Sucrose extraction by mills	90.8	90.4	91.9	91.1	92.3	92.1	92.0	92.5	92.5	92.9
Sucrose in filter press cakes	7.00	6.72	7.97	4.51	4.15	4.36	3.70	3.75	3.81	3.55
Sucrose in juice on 100 cane	11.38	10.77	10.69	11.32	11.83	12.55	11.39	11.97	12.41	11.96
Purity in raw juice	80.95	80.39	82.00	84.41	85.80	86.50	83.7	85.4	85.3	84.6
Purity of final molasses	32.92	32.70	32.45	32.4	32.6	33.1	32.1	32.2	32.4	32.0
Calculated available sugar	10.33	9.94	10.00	10.80	11.40	12.17	10.60	11.31	11.73	11.23
Sugar extracted on 100 canes	10.00	9.76	9.65	10.42	11.00	11.68	10.44	11.13	11.51	11.08
Sucrose Turned out on 100—										
Cane	9.75	9.33	9.18	10.06	10.48	11.27	10.12	10.64	11.00	10.60
Sucrose in cane	77.75	78.34	79.20	81.00	81.75	82.61	81.66	82.23	82.76	82.36
Sucrose in juice	85.77	86.63	86.40	88.90	88.58	89.80	88.85	88.90	88.6	88.34
Sucrose lost on 100—										
Cane	2.79	2.58	2.45	2.36	2.34	2.36	2.26	2.30	2.41	2.27
Sucrose in cane	22.25	21.66	20.87	19.00	18.25	17.39	18.34	17.77	18.12	17.64
Sucrose in juice	14.23	13.37	13.60	11.10	11.42	10.20	11.15	11.10	11.40	11.35
Lost in Bagasse on 100—										
Cane	1.16	1.14	0.94	1.10	0.99	1.08	0.99	0.97	1.00	0.91
Sucrose in cane	9.25	9.57	8.08	8.86	7.72	7.92	7.99	7.50	7.46	7.07
Lost in Filter-cakes on 100—										
Cane	0.11	0.13	0.12	0.10	0.09	0.10	0.09	0.10	0.10	0.09
Sucrose in cane	0.86	1.09	1.03	0.80	0.74	0.73	0.73	0.77	0.75	0.70
Sucrose in juice	0.98	1.21	1.12	0.88	0.80	0.80	0.79	0.80	0.81	0.75
Lost in Molasses on 100—										
Cane	1.22	1.01	1.09	0.85	0.91	0.94	0.90	0.93	1.01	0.98
Sucrose in cane	9.73	8.48	9.38	6.84	7.11	6.95	7.27	7.11	7.16	7.62
Sucrose in juice	10.74	9.35	10.20	7.59	7.70	7.50	7.90	7.80	7.74	8.17
Unaccountable loss on 100—										
Cane	0.30	0.30	0.30	0.36	0.35	0.24	0.28	0.30	0.30	0.29
Sucrose in cane	2.41	2.52	2.38	2.50	2.68	2.17	2.35	2.39	2.75	2.25
Sucrose in juice	2.51	2.81	2.29	2.66	2.92	2.54	2.46	2.50	2.86	2.43

cultivation; two new varieties, raised at the Sugar Experimental Station, are incorporated in these statistics for the first time, while the others occupy about the same area as before.

The total sugar crop amounted to 1,779,557 tons, of which 1,749,649 tons were first sugars and the balance consisted of after-products, calculated back into the equivalent of first runnings by the ratio 4: 3. The figure in the second column of Table III refers, however, to the real weight. In addition, a quantity of 62,125 tons of solidified molasses has been manufactured and shipped.

The percentages of white sugar and the two kinds of refining crystals, relating either to the whole island or to the individual residencies, do not show any great divergencies from former years. The factories are equipped with the machinery designed for the particular assortments, and there has been no reason at all to change them, so that the proportion of the various assortments remains unchanged on the whole.

We have derived our figures for the factory results from the statistics published by the Chemical Department of the Java Sugar Experiment Station. They cover the work done in 151 out of the 182 sugar factories, and therefore do not represent the status of the work done in all sugar-houses, but only in the best of them.

Next to the list of averages, we give here a few maximum and minimum figures, relating to the results of the entire grinding period in the individual factories. We omit names as being of no consequence.

	Maximum.	Minimum.
Sucrose in cane	14·87	10·68
Fibre in cane	17·48	10·79
Sucrose in bagasse	5·68	2·50
Moisture in bagasse	54·36	41·91
Sucrose in filter-press mud (defec.)	10·28	0·31
Sucrose in filter-press mud (carb.)	1·99	0·15
Purity of raw juice	89·2	79·0
Purity of molasses	37·8	27·7
Sucrose in juice on 100 cane	14·14	9·77
Available sugar on 100 cane	13·48	8·66
Raw sugar extracted on 100 cane	13·18	8·76

It will be seen from these averages that the sugar content was rather good, and so was the purity of the raw juice, though not so brilliant as in the exceptionally good year of 1921.

The sucrose and moisture in bagasse are lower than before, thus giving evidence of an improved mill-work, which is also shown by the higher figure for the mill-extraction. This is 92·9 now on an average, or 0·4 better than in the year 1921.

The purity of the final molasses is lower than in any previous year in the present statistics, which is a matter for congratulation, since it proves that a better desaccharification is on the way.

The difference between the maximal calculated output and the real sugar extraction, both calculated to the raw sugar basis on 100 parts of cane, is only 0·15, thus giving evidence of a perfectly-conducted factory work over the whole island.

We give here the data relating to the total sales of Java-sugar and that part carried out by the United Java Sugar Producers, showing that this body controls the sale of 88·5 per cent. of the total Java crop.

Assortment.	Total Sales. Piculs.	Sales by U.J.S.P. Piculs.
Superior head sugar	15,471,104	14,188,222
Superior soft sugar	446,442	357,053
Channel assortment refining crystals, 98° pol.	8,035,361	11,125,160
Refining crystals, 96° pol.	4,818,149	
Molasses sugar	547,792	345,214
Sack-sugar	96,311	25,984
Sundries	21,708	—
Total sales	29,436,867	26,033,633

All the above figures are piculs of 61·76 kg. or 136 lbs. The United Java Sugar Producers started their sales in November, 1921, and continued selling gradually at prices of 11 to 12·25 guilders per picul of superior sugar, 8½ to 11 for the refining crystals, basis 98° polarization, and 8½–10·75 for the refining crystals, basis 96°, till about the month of June, 1922, two-thirds of their sugar had been disposed of. Later on, the price rose still further, so that up to September, at which time all of the sugar in first hands had been sold, prices of 14 guilders for the superior and 12 and 11·75 for the two grades of refining crystals, could be secured. The average selling price of the sugars sold by the United Java Sugar Producers was as follows in guilders per picul:—

Superior	11·92
Refining crystals, basis 98°	10·68
Refining crystals, basis 96°	10·45

We assume the consumption in the Archipelago to be 130,000 tons per annum. The great bulk of the balance has been exported and had left the Island before May, 1923. We are not yet in possession of the detailed figures of exportation, but hope to give them as soon as they have appeared.

Recent Work in Cane Agriculture.

Annual Report of the Insular Experiment Station of the Department of Agriculture and Labour, Porto Rico, 1920-21.

This Report, like its predecessor, commences with a table showing the resignations, appointments and promotions occurring during the year. The Director, E. D. Colón, has devoted considerable attention to this important subject and states now that "efforts to have unessential positions abolished, existing positions of responsibility better remunerated, and necessary new positions created were only partially successful. Except for the salaries, which were not raised as recommended, it is believed that, in general, the personnel, as organized in the department now, will permit of a more efficient work by each service." A sum of $5000 was unused for salaries during the year, through positions being unfilled, but this amount was not used, as recommended, for increasing the salaries of the chiefs of divisions, and only led to a reduction of the sum appropriated for salaries during 1921-22. Such action, in view of past experience, appears to be retrograde, and the waste of power and dislocation of work by frequent changes of officials appears likely to continue.

A considerable improvement has, however, been effected in relieving the officials of the Insular Experiment Station from the many composite duties imposed on them when the Station in 1917 became a subordinate constituent of the newly created Department of Agriculture and Labour. Steps taken during the year have almost completely released the Institute from duties which in the past have been interfering with its investigational work. Thus the inspection and analysis of fertilizers have been taken over by the Bureau of Agriculture; plant inspection and quarantine, formerly under the charge of the Entomologist, are now a separate service; and cattle tick eradication has also been taken over by the Bureau of Agriculture. The expert officers of the Station are thus comparatively free to devote themselves to the multitude of problems awaiting them, although the distribution on large scale of cane seed, which takes up the time of one officer completely (the plant breeder) and one quarter of the Station labour, is still carried on. During the year 134 tons of seed cane were distributed to 138 applicants.

As usual the Director's Report is followed by those of the various chiefs of sections, but owing to the belated receipt of the present pamphlet much of the information regarding sugar cane, contained in these latter Reports, has already been referred to in our columns.[1] There are, however, various points in the work of the different sections which have not been as yet noted.

With regard to the Mosaic disease, the tissues of diseased and healthy plants have been carefully studied. As might be expected, the formation of starch is seriously interfered with, and by carefully selecting the sample it has been possible to correlate the yellow and green mottling of the leaf with yellow and purple by iodine staining in the underlying tissues. The starch sheaths round the bundles were especially significant, hardly any blue coloration being obtained under the yellow stripes, in contrast to the deeply stained sheaths under the green parts of the leaf. In continuation of the work on enzyme activity in diseased and healthy plants, begun last year, a general survey has been started and tests have been made for oxydases, peroxydases, proteoses, zymase and amylase. It is however satisfactory to note that the crest of the wave of infection by the mosaic disease epidemic appears to have been passed, and the general feeling is that this serious disease will now gradually become less of a menace in the island.

A good deal of attention has been attracted to the claim put forward by R. DEL VALLE ZENO that he could induce yellow stripe by appropriate feeding, and that it was mainly caused by excessive nitrogenous applications. A field was placed at his disposal by the Station, where he applied certain ingredients to the plots to demonstrate the correctness of his views. These experiments failed all along the line, yellow stripe appearing in isolated cases, but none in the plots treated for that purpose. J. MATZ, the plant pathologist, at the same time conducted a separate series of experiments, and gave heavy doses of various nitrogenous manures, in some cases killing the plants, but without a trace of yellow stripe appearing. Lack of water, frequent cutting back, and the use of either very young top seed or old bottom seed did not prove to be factors in producing the disease; and soil in which the disease appeared for the first time was used to plant sound seed, which however continued to grow perfectly healthy. It is well that these various points have been authoritatively settled.

In his work on plant diseases in Porto Rico, MATZ found that in many cases the literature on them emanating from other countries proved of little use, and has been driven to the conclusion that this was due to the intrinsic differences between such Porto Rico diseases and those known under the same name in other countries. He instances root disease, yellow stripe and gumming as cases in point. The last named is unfortunately rapidly spreading and becoming a menace to the industry. A careful study of the Java gumming literature showed that the results of experiments conducted there were not obtained in Porto Rico. The bacteria causing the disease were isolated and methods of transmittal worked out, after which all the commoner canes grown in the island and the most promising local, Barbados, and Demerara seedlings were tested as to their liability. The following results were obtained:—(*a*) In susceptible varieties such as Otaheite, B 376, and Rayada the disease can easily be introduced by applying a small mass of the bacteria to the injured surfaces of growing leaves and to tops of cane stalks in a growing condition; (*b*) the mature portions of the cane stalks or their roots are not likely to form receptive channels for the introduction of the disease; (*c*) the disease is not transmitted from plant to plant by way of the soil. It is clear from further experiments that gumming disease of the sugar cane is trans-

[1] *I.S.J.*, 1922, throughout.

mitted by direct inoculation (as was done experimentally) with the cutting instruments, or by insects and driving rain. Otaheite is the most susceptible kind, and he regards it as in reality a carrier which infects the more resistant kinds. There is apparently immediate need for the eradication of infected stools, to prevent the disease from spreading all over the island.

Dry top-rot or root disease, which MATZ states is caused by *Plasmodiophora vascularum* is becoming increasingly common in the island, and is one of the most serious specific diseases of the sugar cane in Porto Rico; and experimental work has been begun to find out its mode of propagation.

QUATRIÈME RAPPORT DE LA STATION AGRONOMIQUE DE LA GUADELOUPE, 1921-2. *C. T. Allder. Point-à-Pitre.*

The newly founded Agricultural Station in Guadeloupe has, during the year, sustained two serious losses. The first of these was a change in directorate, due to the resignation of J. SYDNEY DASH, the founder of the Station, who has joined the staff of the Agricultural College in Trinidad. The second was the total destruction by fire of the offices, library and entomological laboratory of the Department. The new (*pro. tem.*) Director, C. T. ALLDER, shows the right spirit in making the best of things, remarking that the really important results thus far obtained are recoverable in the publications already issued. But the work must be dislocated and hampered, all the same, in various directions.

The lines of study in sugar cane matters are chiefly experiments in manuring, the introduction and comparing of new cane varieties with the local standard kinds, and the raising of seedling canes. Small areas have of necessity been the rule thus far, but the time has arrived for larger plots. Unfortunately, the second ratoons of varieties under trial on estates were reaped before the assumption of his duties by the new Director, and these results have been lost. A break in the mill delayed the crushing for three or four days and thus reduced the sucrose and increased the glucose in some of the analyses; but this has been turned to account in emphasizing the necessity of avoiding such delays on the estates. Heavy rains, occurring during the maturing period of the cane, caused a renewal of growth and a diminution of sucrose in the juice of the best varieties, but accounted for some very heavy yields; St. Croix 12 (4) for instance produced something over 80 tons of cane to the acre.

In the experiments with manures, there were four series of 12 plots, each with one control and the rest devoted to nitrogen alone in the form of nitrate of soda and sulphate of ammonia, and with potash in nitrapo, together with plots of these with potash and phosphorus separately, and one plot with a complete manure containing all three elements. On the whole the plots with nitrogen alone gave the best results, but there were, as in Barbados, contradictions which have made it impossible to draw safe conclusions. A fresh series is being instituted and we trust that more control plots will be introduced into it. The soils of the island are in the main stiff or clayey and often without a trace of lime. This was applied at the rate of five tons to the hectare in certain plots. As was to be expected, the effect on the first year's canes was insignificant, while that in the first ratoons showed a distinct benefit. The extended use of green manuring is strongly recommended by the Director, and a number of plots were laid down to judge of the amount of green material formed by different leguminous plants. "Cocal" and Canavalia gave the best average results during 1919-22, but in the last season two new forms under the names of *Vigna Catiang bruné* and *Vigna Catiang tigrée* headed the list, in contrast with the numerous other cow peas in the general list which were disappointing.

The work on varieties, although only extending through three seasons, was distinctly promising, a number having shown themselves distinctly superior to the standard big Tannas which, although giving large tonnages, are distinctly poor in juice. There appear to be two differing soil areas in the island, the flat eastern half known as Grande Terre, having black soil, and Guadeloupe Proper having red, and these are treated separately. Separate analyses were also made of plant canes and first ratoons, the latter being usually carried on on the estates for two years. Taken generally, as the result of three years' work, there appears to be a promising future for B H 10 (12) and Ba 11569, and these varieties are being propagated as rapidly as possible for distribution. Other forms which have given good results are Ba 6032, B 67, Ba 7924, Ba 12079, B.S.F. 13 (8), and S.C. 12 (4). B 147 has persistently given mediocre returns, while B 208 is evidently out of place, and although its juice is, as always, very good the yield in Guadeloupe is disappointing. Among the new seedlings, G 1, 5, 10, and 15 are considered the most promising, but it is too early to make any recommendations concerning their introduction on the estates.

A CHEAP AND EFFECTIVE METHOD OF PROPPING SUGAR CANES. *T. S. Venkatraman. The Agricultural Journal of India. Vol. XVII, Part IV, July, 1922.*

Lodging of the canes is a serious drawback to cane cultivation in many places, epecially where the growth of the cane is very tall or the soil is of light character, and heavy rains or strong winds prevail when the canes are well grown. To illustrate the difficulties of cultivators, reference is made to the usual custom of propping the canes in the Godavari delta in the Madras Presidency, where some of the tallest canes in the world are grown and there are always chances of sudden wind storms.[1] The average cost of propping the canes of a well grown field in this tract is given as about Rs 80 (£5 to £6) per acre each year. A method has been evolved by the author, and successfully used for two years before publication, which is designed to reduce this heavy expenditure, and should be of general interest wherever lodging has to be fought.

Bamboos are planted upright along the rows at distances of 10 to 20 feet while the canes are from two to three feet high, and plain galvanized iron wire is looped round the poles, making a figure of eight by crossing between them. The canes are led into the spaces between the wires as they grow in height. A convenient thickness of wire is 18 gauge, but this will depend upon the character of the cane and crop. For convenience of handling, the wire is cut into lengths of 40 feet or upwards, and when placed in position is kept from slipping down the bamboos by iron nails hammered into them. At harvest, the wires are slipped up and the canes cut as usual. After use the wires are kept in their loops, by being stretched between bamboos in their place of storage, but they do not remain there long as they are soon needed for the succeeding crop. The cost of this method, allowing for a life of five years of bamboos and wire, has been worked out at less than half of that in use in the Godavari district.

C. A. B.

At a meeting of agriculturists held recently at Woodbridge, Suffolk, it was decided to proceed with a scheme for the establishment of a beet sugar factory at Sudbourne in that county. The required capital outlay is estimated at about £400,000. There is also a proposal on foot to finance a sugar factory in the West of England to serve the contiguous counties of Somerset, Wilts, Hants and Dorset.

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[1] This method and its necessity are illustrated in *I.S.J.*, 1919, pp. 546-7.

The Influence of Alkaline Earths on the Determination of Reducing Sugars by Fehling's Solution.[1]

By LEWIS EYNON, B.Sc, F.I.C., and J. HENRY LANE, B.Sc., F.I.C.,
Chemists, Sugar Association of London.

The remarkable reactivity of various sugars towards calcium hydroxide is well known and has been very thoroughly investigated by a number of workers, e.g., PELIGOT.[2] The possibility, however, that in the determination of reducing sugars by means of Fehling's solution, traces of calcium salts present in the sample under investigation may so alter the rate or course of decomposition of the sugar as to effect the result appreciably appears to have been quite overlooked.

Some discordant results that we obtained in the course of our investigation of the volumetric determination of reducing sugars by Fehling's solution with methylene blue as internal indicator[3] led us to the discovery that traces of calcium salt may be responsible for very considerable errors. Experiments with salts of other metals have shown that besides salts of calcium, only those of the other alkaline-earth metals, strontium and barium, exert a similar distributing effect on the determination of reducing sugars.

In the following experiments, solutions of invert sugar were prepared according to the method previously described, neutralized with sodium hydroxide, and then diluted to 0·2 per cent. concentration with (*a*) distilled water, (*b*) solutions of various metals at various concentrations. The reducing power at each solution was then determined against 10 c.c. of Fehling's solution by the standard method of titration previously described.[4] Table I shows the results obtained with the alkaline-earth salts and with the salts of those other metals which are likely or possible constituents of various commercial sugar products. The results of experiments with lead acetate are also given, as these are of importance in connexion with the clarification of raw sugar products:—

TABLE I.

(The figures given represent c.c. of sugar solution required.)

Concentration of salt used.	SALT USED.								
	$CaCl_2$.	$SrCl_2$.	$BaCl_2$.	$MgSO_4$.	$MgCl_2$.	$Al_2(SO_4)_3$.	NH_4Cl.	KCl.	$Pb(C_2H_3O_2)_2$
N/∞	25·6	25·6	25·6	25·6	25·6	25·6	25·6	25·6	25·6
N/500	25·9	26·05	25·95	—	—	—	—	—	—
N/250	26·1	26·4	26·1	25·65	—	—	—	—	—
N/100	26·6	27·05	26·45	—	25·65	25·6	25·5	25·6	25·7
N/50	27·25	27·7	27·0	25·65	—	—	—	—	—
N/25	27·0	28·2	27·65	—	—	—	—	—	—
N/10	26·0	26·5	27·7	—	25·6	25·75	25·25	25·6	—

These figures show in a very striking manner how serious is the influence of salts of calcium, etc., even at so high a dilution as N/500, upon the volumetric determination of invert sugar with Fehling's solution. It should be mentioned that at such concentrations as N/25 and N/10 of alkaline-earth salt, the end-point is very indistinct. The salts of the other metals exert little or no effect on the result, even at a concentration of N/100, and at concentrations higher than this only the lead salt has any considerable effect.

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[1] Slightly abridged from *J. Soc. Chem. Ind.*, 1923, 42, No. 14, 143–146T.
[2] *Comptes rendus*, 1879, 89, 919. [3] *I.S.J.*, 1923, 143. [4] *Loc. cit.*

In a second series of experiments the influence of calcium chloride, at N/100 concentration, on the volumetric determination of the more important reducing sugars was investigated. Solutions of the sugars were titrated against 10 c.c. of Fehling's solution by our standard method. The results are given in Table II. The figures given represent the number of c.c. of sugar solution required by 10 c.c. of Fehling's solution.

TABLE II.

(The figures given represent c.c. of sugar solution required.)

SUGAR USED—	Solution in distilled water.		Solution in N/100 calcium chloride.
Dextrose	24·77	....	25·77
Levulose	26·4	....	27·15
Lactose	27·35	....	29·15
Maltose	26·5	....	27·3

The above results show clearly that the volumetric determination of reducing sugars in general is very seriously vitiated by the presence of even small quantities of calcium (or strontium or barium) salts. The greater sensitiveness in this respect of lactose as compared with the other reducing sugars is, no doubt, due to the fact that lactose is less rapidly oxidized by Fehling's solution, and there is, therefore, more opportunity for the lime to act upon the sugar. Incidentally, it may be mentioned that the use of supply water instead of distilled water for making up a sugar solution for the determination of reducing sugar causes error if, as is generally the case, the supply water contains calcium salt. Thus, of two solutions of dextrose of equal concentrations, one prepared with distilled water and the other with a calcareous supply water (containing about 40 parts of solids per 100,000), 26·7 c.c. of the former and 27·3 c.c. of the latter were required to reduce 10 c.c. of Fehling's solution.

Since raw cane and beet sugars, syrups and molasses always—and starch sugar commonly—contain small quantities of calcium salts, it is obviously necessary to remove these prior to the determination of reducing sugars unless the proportion of the latter is very small. We have tried various precipitants and have found that small quantities of calcium salts may be very effectively removed by the addition of sodium or potassium oxalate. Sodium carbonate and sodium phosphate, on the other hand, effect only a partial removal of the calcium, and cannot therefore be recommended for the purpose. In the following series of experiments (Table III) 50 c.c. portions of a 1 per cent. acid solution of invert sugar were neutralized with sodium hydroxide, then treated with the reagents mentioned in the first column, made up to 250 c.c., and filtered. The filtrate was titrated against 10 c.c. of Fehling's solution, the number of c.c. required being shown in column 2.

TABLE III.

Method of treating before diluting to 0·2 per cent. Concentration.	C.c. of Invert Sugar Solution required to reduce 10 c.c. of Fehling's Solution. c.c.
(1) No addition	25·47
(2) 25 c.c. of N/10 calcium chloride added	26·45
(3) 25 c.c. of N/10 calcium chloride, and then sodium oxalate and alumina added	25·45
(4) 25 c.c. of N/10 calcium chloride, and then sodium carbonate and alumina added	25·75
(5) 25 c.c. of N/10 calcium chloride, and then sodium phosphate and alumina added	26·07

It is evident that the removal of calcium salt by oxalate is very complete, the reducing power of the invert sugar solution after treatment with calcium chloride and sodium oxalate being practically the same as that of the untreated solution.

In view of the foregoing experiments we have determined the reducing sugar and sucrose (by hydrolysis and copper reduction) in cane and beet molasses and raw cane sugars, using: (1) the untreated solution; (2) the solution after treatment with sodium or potassium oxalate and filtration.

The cane molasses sample used contained calcium salt equivalent to 0·9 per cent. of calcium oxide and a total of 8·5 per cent. of mineral matter.

	Without treatment. Per cent.		After treatment with Sodium Oxalate and Filtration. Per cent.
Reducing sugars	21·8	......	23·3
Sucrose..	37·4	......	38·0

The beet molasses sample used contained calcium salt equivalent to 0·3 per cent. of calcium oxide and a total of 11·8 per cent. of mineral matter.

	Withou treatment. Per cent.		After treatment with Oxalate and Filtration. Per cent.
Reducing sugars	1·94	....	2·04
Sucrose..	47·0	....	47 3

Sample No. 1 of raw cane sugar polarized 94·35 and contained 0·98 per cent. of mineral matter; and sample No. 2 polarized 79·9 and contained 2·30 per cent. of mineral matter, the following results for the reducing sugars being found :—

	Without treatment. Per cent.		After treatment with Oxalate and Filtration. Per cent.
Sample 1	1·05	....	1·10
,, 2	6·87	....	7·04

These results fully bear out those obtained with pure reducing sugars, and show that the calcium salts present in raw sugar products may seriously affect the determination of the sugars with Fehling's solution, the results obtained being lower than the true values. As indicated by the results quoted in Table III, the calcium salts are very effectively removed by addition of potassium or sodium oxalate solution. We have found that a 10 per cent. solution of potassium oxalate is convenient for this purpose; 5 c.c. of a solution of this concentration suffices to remove all the calcium salt likely to be present in 10 grms. of a sample of molasses, and a smaller quantity will, of course, be enough for raw sugars, though in any case an excess of the oxalate does not affect the accuracy of the determination. It is advisable to add a small quantity of alumina cream to the solution after the addition of the oxalate solution and before making up the volume, in order to assist filtration.

It is especially interesting to note that the Association of Official Agricultural Chemists recommends the use of potassium oxalate for removing the excess of neutral lead acetate used for clarification. The oxalate, however, besides removing the lead, also eliminates any calcium salts that may be present in the solution, though the need for this does not appear to have been realized hitherto.

Then Meade and Harris[1] have obtained results showing: (*1*) that after clarification with normal lead acetate, and removal of the excess lead with potassium oxalate, the reducing power is greater (by 4 to 5 per cent.) than when sodium carbonate, phosphate, or sulphate is used as de-leading agent, and still

[1] *I.S.J.*, 1917, 527.

greater than that of the unclarified solution; and (2) that treatment of unclarified molasses solution with potassium oxalate only, and filtration from the precipitated calcium oxalate, gives a solution of greater reducing power than that of the original clarified solution. As pointed out by these authors, these differences are contrary to what would be expected if lead clarification removed copper reducing non-sugars, and they observe that "oxalate alone, without lead, gives figures corresponding to those with lead and oxalate."

In the light of our experiments it appears extremely probable that the apparent contradictions observed by MEADE and HARRIS are completely and solely to be explained by the presence of calcium salts in the molasses. That, as found by these authors, de-leading agents other than potassium oxalate give lower results, is to be explained by the incomplete removal of calcium salts, and is fully borne out by our own experiments (see Table III).

NORRIS and BRODIE[1] have stated that potassium oxalate is unsuitable for the removal of the excess of lead on the ground that the excess of oxalate left in solution causes the precipitation of a slight excess of copper. SAWYER,[2] however, had previously shown this not to be so when working gravimetrically, a conclusion that has been fully confirmed by MEADE and HARRIS, and also by us, when using the volumetric method.

In view of our results, it is practically certain that the greater precipitation of cuprous oxide observed by NORRIS and BRODIE after the use of potassium oxalate was due to the removal of a small quantity of calcium salt from the molasses. NORRIS and BRODIE recommended disodium phosphate as de-leading agent on the grounds that it entirely removes the lead and has no effect on the copper reduction. But, as we have shown (Table I), the absolutely complete removal of the lead is not necessary, the faint trace left after the potassium oxalate treatment being quite without influence. In fact, even at a concentration of N/100, it has no practical effect on the volumetric result. Further, the use of disodium phosphate is objectionable, owing to the fact that, as stated above, it does not effect complete precipitation of calcium salt, being even less satisfactory in this respect than sodium carbonate (Table III). Whilst on the other hand, potassium oxalate removes the lead quite sufficiently, at the same time it performs the much more important service of removing the calcium salt completely.

Methods of Boiling and Crystallizing Low Grade Sugars followed in Hawaiian Factories.

In a report made to the Chairman of the Committee on the Manufacture of Sugar and Utilization of By-Products, appointed by the Hawaiian Sugar Planters' Association, Mr. WM. SEARBY enclosed a tabulation (see opposite page) of the methods of boiling and crystallizing low grades followed by 29 factories in Hawaii.[3]

Points to which attention was drawn by Mr. SEARBY were the following: Three factories use powdered sugar in starting the low grades, while a fourth resorts to the use of the natural grain in the molasses. Second sugars having purities ranging from 72 to 85° are reported, and this particular phase of low grade work is one demanding attention, as the higher the purity of second sugar from a given massecuite, the less impurity there will be in circulation.

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[1] *I.S.J.*, 1918, 238. [2] *J. Amer. Chem. Soc.*, 1904, 26, 1631.
[3] A portion only of this tabulation is here reproduced.

Methods of Boiling and Crystallizing Low Grade Sugars.

Factory.	Method of Boiling.	Crystallizers, Coolers, or Tanks.	Diluent.	Centrifugal Drying.	Utilization of the Low Grade Sugar, and its Purity.
Olaa Sugar Company	Base of No. 1 molasses, and syrup if necessary, grained, and finished up with molasses to 96° Brix	7 days in the crystallizers	A little water added to prevent super-saturation		Mostly used for seed direct; balance re-melted with with syrup
Onomea Sugar Company	No. 1 molasses 50–53° A.P., grained, and built up to 97–99° Brix	7–10 days in crystallizers in motion	Waste molasses (heated) to give 92° Brix	18 machines, 14 in. × 30 in.	Mixed with syrup to 90–91° Brix. Purity, 81–83°
Hakalau	No. 1 molasses of 52° purity, boiled to grain, and built up to 97–97·5 Brix	8 days in the crystallizers	Water added after four days to bring Brix down to 94°	10 machines, 30 in. 2 machines, 40 in., 1 hour each	Mixed with syrup for seeding No. 1 massecuite, surplus re-melted and boiled back on No. 1 massecuite
McBryde	No. 1 molasses at 54–62° A.P. boiled to proof, powdered sugar added allowed to stand, cut, and built up	8–10 days in crystallizers in motion	None		Re-melted with press juice
Pepeekeo	No. 1 molasses boiled to 92–93° Brix and allowed to cool and drain. Drawn into pan and built up to 96° Brix and 51° purity	7 days in the crystallizers	Water added slowly, reducing Brix to 93°	30 in. machines 1 hour, 1 pint water added	Mingled with syrup and press juice. Purity, 80–85°
Hawaiian Commercial and Sugar Company	No. 1 molasses seeded with powdered sugar, built up with No. 1 molasses, cut twice, and finished off with No. 1 molasses	14–16 days in the crystallizers			Purity, 73°
Oahu Sugar Company, Ltd.	No. 1 molasses of 60° purity, grained in small pan, cut to large pan, and built up to 99° Brix and 56° purity	5-9 days in closed crystallizers	Water, depending on time available	Average Brix at machines, 96°	Magma of low grade sugar and No. 1 molasses used to seed No. 1 strike
Ewa Plantation Company	No. 1 molasses of 60° purity, grained, cut in two, and built up to 99–100° Shock seeding with good results	30 galls. water in 1000 C.F. crystallizers to prevent secondary grain	Water in very small stream, or waste molasses to thin out	Steam used between basket and shell to accelerate drying	
Maui Agricultural Company	No. 1 molasses and syrup, grained, and built up with molasses to 56° purity and 96–100° Brix	1–3 weeks in crystallizers, 2 hours' motion each night	None	15 machines, 24 in. × 40 in.; 40–60 minutes' steam to assist occasionally	Re-melted with water
Pioneer Mill Company, Ltd.	10 tons "natural grain" built up to 30 tons, cut in thirds. Each third built up to 30 tons, cut over, and built up to 60 tons, 97° Brix, and 55° purity	Crystallizers. No stirring necessary after first day	None	30 in. and 40 in. machines, 1–1½ hours each	Mingled with syrup to form seed. Purity, 80 85°

Comparison of Pan Boiling Systems in respect of the In-Boiling of Non-Sugars.[1]

By H. C. WELLE.

In this article calculations and suggestions are extended for the purpose of showing the relative amount of non-sugars introduced when four of the simplest systems of boiling in raw sugar production are followed. Naturally, the figures tabulated are subject to local conditions; and the data are put forward purely as a suggestion and a guide for a study of individual cases.

System A.

For Producing Two Grades of Raw and a Double-purged Low-grade Sugar.

In regard to basic data, the following true purity values of the various products are assumed:—Syrup, 87·0°; first raw, 97·5°; second raw, 96·6°; second molasses (from second raw), 57·0°; low-grade sugar, 89·0°; and waste molasses, 40·0°. It is also assumed that the yield of the first pan is 55 tons dry raw per 100 tons of dry massecuite or syrup.

Then $55 \times 97{\cdot}5 \times 100/87 = 61{\cdot}6$ per cent. sucrose in first raw on sucrose in the syrup. Therefore, $100 \times 97{\cdot}5\,(87 - M)/87\,(97{\cdot}5 - M) = 61{\cdot}6$; and $M = 74{\cdot}2°$, the true purity of the first molasses. So that the composition of the first pans will be as follows:—

	Sucrose, tons.		Non-sucrose, tons.		Total, tons.
First raw, 97·5° purity	53·6	..	1·4	..	55·0
First molasses, 74·2° purity....	33·4	..	11·6	..	45·0
First massecuite, 87·0° purity ..	87·0	..	13·0	..	100·0

The total extractable sucrose in 100 tons of dry syrup of 87·0° purity (true) can be expressed as follows: $87 - S/100 - S = 0{\cdot}40$; and $S = 78{\cdot}33$ tons. That in 100 tons of dry raw sugar of 97·5 purity is: $97{\cdot}5 - S/100 - S = 0{\cdot}40$; and $S = 95{\cdot}83$ tons. Therefore, $0{\cdot}9583 \times 55{\cdot}0 = 52{\cdot}71$ tons of extractable sucrose in the 55 tons of 97·5 first raws; and $78{\cdot}33 - 52{\cdot}71 = 25{\cdot}62$ tons of extractable sucrose in the 96·6 second raws, assuming that all the low-grade sugar is taken back into the second raw pans.

The total extractable sucrose in 100 tons of dry raw sugar of 96·6 purity is: $96{\cdot}6 - S/100 - S = 0{\cdot}40$; and $S = 94{\cdot}3$ tons. Therefore, $100 \times 25{\cdot}62/94{\cdot}3 = 27{\cdot}17$ tons of 96·6° second raws that will give 25·62 tons of extractable sucrose. Therefore $(27{\cdot}17 \times 96{\cdot}6) + (55 \times 97{\cdot}5)/27{\cdot}17 + 55 = 97{\cdot}20$, the true purity of the average raws.

From the preceding calculations it follows that: $55{\cdot}0 + 27{\cdot}17 = 82{\cdot}17$ tons of 97·2° purity raws will be recovered from 100 tons of dry syrup of 87·0° purity with a waste molasses of 40·0° true purity. Therefore, $100{\cdot}00 - 82{\cdot}17 = 17{\cdot}83$ tons of dry 40° purity molasses of $0{\cdot}40 \times 17{\cdot}83 = 7{\cdot}13$ tons sucrose content, leaving 10·70 tons of non-sucrose content.

Further, $100 \times 89\,(57 - 40)/57\,(89 - 40) = 54{\cdot}17$ per cent. sucrose in the low-grade sugar on the sucrose in the third massecuite. And let x = tons of dry third massecuite; then $x - 17{\cdot}83$ = tons of dry low-grade sugar; $0{\cdot}89\,(x - 17{\cdot}83)$ = tons of sucrose in the low-grade sugar; and $0{\cdot}57x$ = tons of sucrose in the third massecuite. Therefore, $89\,(x - 17{\cdot}83) \times 100/0{\cdot}57x = 54{\cdot}17$; and $x = 27{\cdot}30$ tons of dry third massecuite. Therefore, the composition of the third pans will be as follows:—

[1] Paper presented with the Report of the Committee on Manufacture of Sugar and Utilization of By-Products, Hawaiian Sugar Planters' Association, 1922.

	Sucrose, tons.		Non-sucrose, tons.		Total, tons.
Low-grade sugar, 89·0° purity..	8·43	..	1·04	..	9·47
Waste molasses, 40·0° purity ..	7·13	..	10·70	..	17·83
Third massecuite, 57·0° purity..	15·56	..	11·74	..	27·30

As it is assumed that all the first molasses and all the low-grade sugar goes to make up the second massecuite, it follows that the latter will have the following composition :—

	Sucrose, tons.		Non-sucrose, tons.		Total, tons.
First molasses, 74·2° purity ..	33·40	..	11·60	..	45·00
Low-grade sugar, 89·0° purity..	8·43	..	1·04	..	9·47
Second massecuite, 76·79° purity	41·83	..	12·64	..	54·47

Then the composition of the second pans will be stated as follows :—

	Sucrose, tons.		Non-sucrose, tons.		Total, tons.
Second raw, 96·6° purity	26·25	..	0·92	..	27·17
Second molasses, 57·0° purity ..	15·58	..	11·72	..	27·30
Second massecuite, 76·79° purity	41·83	..	12·64	..	54·47

Note that the total raw sugar produced would be 82·17 tons of 97·2° average true purity.

SYSTEM B.

For Producing Two Grades of Raw and a Single-purged Low-grade Sugar.

In regard to basic data, the following true purity values are assumed:— Syrup, 87·0°; first raw, 97·5°; second raw, 96·6°; second molasses (from second raw), 57·0°; low-grade sugar, 73·0; and waste molasses, 40·0°. It is again assumed that the yield of the first pan is 55 tons of dry raw per 100 tons of dry massecuite or syrup.

Then, as in System A, the composition of the first pans will be as follows :—

	Sucrose, tons.		Non-sucrose tons.		Total, tons.
First raw, 97·5° purity	53·6	..	1·4	..	55·0
First molasses, 74·2° purity..	33 4	..	11·6	..	45·0
First massecuite, 87·0° purity.. ..	87·0	..	13·0	..	100·0

And the yield of total raw sugar, and the quantity of waste molasses will also be the same as in System A. Then the continuation of the calculation is as follows: $100 \times 73\,(57 - 40)/57\,(73 - 40) = 65{\cdot}98$ per cent. sucrose in the low-grade sugar on the sucrose in the third massecuite. Let x = tons of dry third massecuite; then $x - 17{\cdot}83$ = tons of dry low-grade sugar; $0{\cdot}73\,(x - 17{\cdot}83)$ = tons of sucrose in the low-grade sugar; and $0{\cdot}57x$ = tons of sucrose in the third massecuite. Therefore, $100 \times 0{\cdot}73\,(x - 17{\cdot}83)/0{\cdot}57x = 65{\cdot}98$, giving $x = 36{\cdot}78$ tons of dry third massecuite. So the composition of the third pans will be as follows :—

	Sucrose, tons.		Non-sucrose, tons.		Total, tons.
Low-grade sugar, 73·0° purity..	13·83	..	5·12	..	18·95
Waste molasses, 40·0 purity....	7·13	..	10·70	..	17·83
Third massecuite, 57° purity ..	20·96	..	15·82	..	36·78

As it is assumed that all the first molasses and all the low-grade sugar goes to make up the second massecuite, it follows that the latter will have the following composition :—

	Sucrose, tons.		Non-sucrose, tons.		Total, tons.
First molasses, 74·2° purity ..	33·40	..	11·60	..	45·00
Low-grade sugar, 73·0° purity..	13·83	..	5·12	..	18·95
Second massecuite, 73·85° purity	47·23	..	16·72	..	63·95

Then the composition of the second pans can be stated as follows:—

	Sucrose, tons.		Non-sucrose, tons.		Total, tons.
Second raw, 96·6° purity	26·25	..	0·92	..	27·17
Second molasses, 57·0° purity ..	20·98	..	15·80	..	36·78
Second massecuite, 73·85° purity	47·23	..	16·72	..	63·95

SYSTEM C.

For producing One Grade of Raw and a Double-purged Low-grade Sugar.

In regard to basic data, the following true purity values are assumed:—Syrup, 87·0°; raw sugar, 97·2°; first massecuite, 80·0; first molasses, 57·0°; low-grade sugar, 89·0°; and waste molasses, 40·0°.

The composition of the low-grade pans, in this case the second pans, will be the same as calculated for System A, namely as follows:—

	Sucrose, tons.		Non-sucrose, tons.		Total, tons.
Low-grade sugar, 89·8° purity..	8·43	..	1·04	..	9·47
Waste molasses, 40·0 purity....	7·13	..	10·70	..	17·83
Second massecuite, 57·0° purity.	15·56	..	11·74	..	27·30

It is assumed that all the low-grade sugar of 89° purity is taken into the first massecuite, the pan being afterwards "topped off" with first molasses to reduce it to 80° purity (true). Then the base of the massecuite will have the following composition:—

	Sucrose, tons.		Non-sucrose, tons.		Total, tons.
Syrup, 87·0° purity..	87·00	..	13·00	..	100·00
Low-grade sugar, 89·0° purity..	4·43	..	1·04	..	9·47
Base of first massecuite, 87·18° purity..	95·43	..	14·04	..	109·47

Further, $100 \times 87{\cdot}18\,(80 - 57)/80\,(87{\cdot}18 - 57) = 83{\cdot}05$ per cent. of sucrose in the case of the sucrose in the first massecuite. And let x = tons of first massecuite; $0{\cdot}8x$ = tons of sucrose in the first massecuite; and $100 \times 95{\cdot}43/0{\cdot}8x = 83{\cdot}05$; giving $x = 143{\cdot}63$ tons of first massecuite. Then the composition of the first massecuite will be as follows:—

	Sucrose, tons.		Non-sucrose, tons.		Total, tons.
Syrup, 87·0° purity	87·00	..	13·00	..	100·00
Low-grade sugar, 89·0° purity..	8·43	..	1·04	..	9·47
First molasses, 57·0° purity ..	19·47	..	14·69	..	34·16
First massecuite, 80·0° purity ..	114·90	..	28·73	..	143·63

Now, $100 \times 97{\cdot}2\,(80 - 57)/80\,(97{\cdot}2 - 57) = 69{\cdot}15$ per cent. sucrose in the raw sugar on the sucrose in the massecuite. So that the composition of the first pans can be written as follows:—

	Sucrose, tons.		Non-sugar, tons.		Total, tons.
Raw sugar, 97·2° purity	79·87	..	2·30	..	82·17
First molasses, 57·0° purity	35·03	..	26·43	..	61·46
First molasses, 80·0° purity ..	114·90	..	28·73	..	143·63

Note that the raw sugar produced would be 82·17 tons of 97·2° average true purity.

System D.

For Producing One Grade of Raw Sugar and a Single-purged Low-grade Sugar.

In regard to basic data, the following true purity values are assumed:—Syrup, 87·0°; raw sugar, 97·2°; first massecuite, 80·0°; first molasses, 57·0°; low-grade sugar, 73·0°; and waste molasses, 40·0°.

The composition of the low-grade pans, in this case the second pans, will be the same as calculated for System B, as follows:—

	Sucrose, tons.	Non-sucrose, tons.	Total tons.
Low-grade sugar, 73·0° purity..	13·83	.. 5·12	.. 18·95
Waste molasses, 40·0 purity....	7·13	.. 10·70	.. 17·83
Second massecuite, 57·0° purity.	20·96	.. 15·82	.. 36·78

It is assumed that all the low-grade sugar of 73·0° true purity is taken into the first massecuite, the pan then being "topped off" with first molasses to reduce it to 80·0° true purity. Then the base of the first massecuite will have the following composition:—

	Sucrose, tons.	Non-sucrose, tons.	Total, tons.
Syrup, 87 0° purity	87·00	.. 13·00	.. 100·00
Low-grade sugar, 73·0° purity	13·83	.. 5·12	.. 18·95
Base of first massecuite, 84·77° purity.	100·83	.. 18·12	.. 118·95

Further, 100 × 84·77 (80 — 57) / 80 (84·77 — 57) = 87·76 per cent. sucrose in the case on sucrose in the first massecuite. Let x = tons of first massecuite; $0{\cdot}8x$ = tons of sucrose in the first massecuite; and 100·83 × $100/0{\cdot}8x$ = 143·61 tons of first massecuite. Then the composition of the first massecuite will be as follows:—

	Sucrose, tons.	Non-sucrose, tons.	Total, tons.
Syrup, 87·0° purity	87·00	.. 13·00	.. 100·00
Low-grade sugar, 73·0° purity..	13·83	.. 5·12	.. 18·95
First molasses, 57·0° purity ..	14·06	.. 10·60	.. 24·66
First massecuite, 80 0° purity ..	114·89	.. 28·72	.. 143·61

From System C we find that there are 79·87 tons of sucrose in the raw sugar, so that the composition of the first pan can be written as follows:—

	Sucrose, tons.	Non-sucrose, tons.	Total, tons.
Raw sugar, 97·2° purity	79·87	.. 2·30	.. 82·17
First molasses, 57·0° purity	35·02	.. 26·42	.. 61·44
First massecuite, 80·0° purity ..	114·89	.. 28·72	.. 143·61

Yield of Pans by the Four Systems considered.

	Sucrose, tons.	Non-sucrose, tons.	Total, tons.
System A (two raws, double-purge)—			
First pans, 87·0° purity	87·00	.. 13·00	.. 100·00
Second pans, 76·79° purity....	41·83	.. 12·64	.. 54·47
Third pans, 57·00° purity ..	15·56	.. 11·74	.. 27·30
Totals, 79·43° purity....	144·39	.. 37·38	.. 181·77
System B (two raws, single-purge)—			
First pans, 87·0° purity	87·00	.. 13·00	.. 100·00
Second pans, 73·85° purity....	47·23	.. 16·72	.. 63·95
Third pans, 57·0° purity	20·96	.. 15·82	.. 36·78
Totals, 77·31° purity....	155·19	.. 45·54	.. 200·73

	Sucrose, tons.		Non sucrose, tons.		Total, tons.
System C (one raw, double-purge)—					
First pans, 80·0° purity	114·90	..	28·73	..	143·63
Second pans, 57·0° purity	15·56	..	11·74	..	27·30
Totals, 76·32° purity ..	130·46	..	40·47	..	170·93
System D (one raw, single-purge)—					
First pans, 80·0° purity	114·89	..	28·72	..	143·61
Second pans, 57·0° purity	20·96	..	15·82	..	36·78
Totals, 75·31° purity ..	135·85	..	44·54	..	180·39

COMPOSITION OF MASSECUITES BY THE FOUR SYSTEMS CONSIDERED.

	Sucrose, tons.		Non sucrose, tons.		Total, tons.
System A (two raws, double-purge)—					
First massecuite:					
Syrup, 87·0° purity..	87·00	..	13·00	..	100·00
Second massecuite:					
Molasses from first mass., 74·2° purity..	33·40	..	11·60	..	45·00
Sugar from l. g. massecuite, 89·0° purity	8·43	..	1·04	..	9·47
Second massecuite, 76·79° purity	41·83	..	12·64	..	54·47
Third massecuite:					
Molasses from second mass., 57·0° purity	15·56	..	11·74	..	27·30
System B (two raws, single-purge)—					
First massecuite:					
Syrup, 87·0° purity..	87·00	..	13·00	..	100·00
Second massecuite:					
Molasses from first mass., 74·2° purity..	33·40	..	11·60	..	45·00
Sugar from l. g. massecuite, 73·0° purity	13 83	..	5·12	..	18·95
Second massecuite, 73·85° purity	47·23	..	16·72	..	63·95
Third massecuite:					
Molasses from second mass., 57·0° purity	20·96	..	15·82	..	36·78
System C (one raw, double-purge)—					
First massecuite:					
Syrup, 87·0° purity..	87·00	..	13·00	..	100·00
Molasses from first mass., 57·0° purity..	19·47	..	14·69	..	34·16
Sugar from l. g. massecuite, 89·0° purity	8·43	..	1·04	..	9·47
First massecuite, 80·0° purity	114·90	..	28·73	..	143·63
Second massecuite:					
Molasses from first mass , 57·0° purity..	15·56	..	11·74	..	27·30
System D (one raw, single-purge)—					
First massecuite :					
Syrup, 87·0° purity..	87·00	..	13·00	..	100·00
Molasses from first mass., 57·0° purity..	14·06	..	10·60	..	24·66
Sugar from l. g. massecuite, 73·0 purity	13·83	..	5·12	..	18·95
First massecuite, 80·0° purity	114·89	..	28·72	..	143·61
Second massecuite:					
Molasses from first mass., 57·0° purity..	20·96	..	15·82	..	36·78

DISCUSSION OF DATA OBTAINED.

Inspection of these tables will bring out the following comparative data:—

	Non-sucrose in Raw Pans.	Non-sucrose in Low-grade Pans.
A and B	16% greater in B ..	35% greater in B
C and D	Same ..	35% greater in D
A and C	12% greater in C ..	Same
A and D	12% greater in D ..	34% greater in D

In short, it appears that System A (two raws and a double purge of the low-grade sugar) introduces the least non-sucrose into the boiling system, while Systems B and D (two raws and a single-purge, and one raw and a single-purge) introduce the most. If this were all that mattered it would follow that System D might be preferred to System B because of its probable greater simplicity.

But the greatest evil from non-sucrose is incurred through its overprocessing resulting from excessive in-boiling. Looking at the matter from this standpoint, and analysing the preceding data, we find that the tonnage of non-sucrose *returned* to the raw sugar pans from lower products, that is, in-boiled, is as follows, per 100 tons dry syrup of 89° true purity entering the boiling-house:—

	Tons.
System A (two raws + double-purge of low-grade)	1·04
System B (two raws + single-purge of low-grade)	5·12
System C (one raw + double-purge of low-grade)	15·73
System D (one raw + single-purge of low-grade)	15·72

Further, assuming the smallest tonnage of non-sucrose (11·74 tons) to be the minimum required in the process for the low-grade massecuite, we find upon analysis of the preceding data, that the excess non-sucrose introduced into the low-grade massecuite of each system (that is, in-boiling) is as follows:—

	Tons.
System A (two raws + double-purge of low-grade)	Nil
System B (two raws + single-purge of low-grade)..	4·08
System C (one raw + double-purge of low-grade)	Nil
System D (one raw + single-purge of low-grade)..	4·08

It would appear, therefore, that System A (two raws and double-purge of low-grade sugar) would be preferable from both the standpoint of the plantation and the refinery. The possibility of the first raw being too high in polariscopic test could be most satisfactorily met by "painting" same in the centrifugals with a small amount of fresh molasses. Such contingencies as an increase in the purity of the molasses through a double-purging of the low-grade sugar, how to avoid or correct it, cannot be discussed until it is learned if such a condition actually would exist and to what extent. It is quite possible that elimination of the excess of non-sucrose from the system by a double-purging system would so improve the quality of the low-grade and consequent crystallization as to more than counterbalance the evil of a possible slight solution of crystals.

It has been found[1] in the fields of the Pampanga Sugar Mills that wherever press cake has been applied for its fertilizing value, the mosaic disease is very much in evidence. On the other hand, in certain sections of Pampanga, where cultivation is not practised to any considerable extent, mosaic-infected cane is rare. As it has been recently discovered that the *aphis* is the medium of mosaic propagation, it is quite possible that press-cake supports certain types of grasses which are the habitat of the *aphis*. It has been found that the cultivation of cane and the disturbing of these grasses drives the *aphis* from the grass to the cane.

[1] *Sugar News*, 1923, 4, No. 2, 84.

Report on the Manufacture of Industrial Alcohol from Molasses in Hawaii.[1]

By W. L. McCLEERY and H. P. AGEE.

The problem whether plantations in the T. H. can utilize their molasses for the manufacture of industrial alcohol is an economic question. With gasoline and kerosene at an average price for the last five years of 25 and 17 cents per (U.S.) gall. respectively, it is not an inviting proposition. Selling motor fuel locally in competition with gasoline under the well-organized facilities of the various oil companies is not encouraging. Such opportunities as can be considered are confined to production for plantation consumption, either of motor fuel for tractors, trucks and cars, or of stove alcohol for the labourers' kitchens.

Data on Motor Fuel and Stove Alcohol.

On the average each ton of raw sugar produced is accompanied by the formation of about 42 gall. of molasses, which should yield about 15 gall. of industrial alcohol. Probably most plantations in the T. H. are capable of consuming 10 gall. of alcohol for every ton of sugar made, that is, 3 gall. of motor fuel and about 7 of stove fuel. Therefore, the capacity to produce is in excess of the capacity to consume.

Leaving out of consideration the value of the molasses itself as a raw material, it will cost about 8 to 11 cents to produce 1 gall. of industrial alcohol. It takes about 1·4 gall. of motor alcohol to do the work of 1 gall. of gasoline; and about 1·75 of stove alcohol to supply the heat of 1 gall. of kerosene. With gasoline at 25 cents, molasses made into motor alcohol has a value of $4.00 per ton after deducting 10 cents. per gall. as the cost of manufacture; while with kerosene at 17 cents this raw material has a value of only $1.20 per ton when converted into stove alcohol, after deducting 8 cents per gall. as the cost of manufacture.

Unquestionably the subject of the manufacture of industrial alcohol from molasses holds much importance, as in it there exists a safeguard against high prices for motor fuels and burning oils in the event of the rapid decline of the world's supply of oil, of which in recent years very serious predictions have been made. We therefore feel it will be of interest to present details of such information as we have obtained on the subject.

Present Alcohol Production in the T. H.

The Maui Agricultural Co., Paia, T. H., has now in operation a distillery making motor fuel and stove fuel. Its output during the period of 12 months ending August 31st, 1922, was about 59,000 gall. of motor fuel, and 53,000 gall. of stove fuel, a total of about 112,000 gall. The Company is now operating 32 trucks, 20 passenger cars, and two tractors with the motor fuel; while 500 stoves used in the kitchens of the labourers and skilled employees are fed with stove alcohol.

Both the motor and stove alcohols are manufactured on the basis of compositions invented by J. P. Foster, who has been granted patents in the U.S. and elsewhere,[2] for a mixture of alcohol, ether, kerosene, and aniline or pyridine, Formula 3 of which mixture has been accepted as a denatured industrial alcohol by the U.S. Treasury Department. The alcohol motor fuel has the following composition:—Alcohol, 75·2; ether, 22·6; kerosene, 1·5; and pyridine or aniline, 0·7 per cent. Pyridine has been used so far, but aniline is to be substituted in

[1] Presented to the Committee on the Manufacture of Sugar and the Utilization of By-Products, appointed by the Hawaiian Sugar Planters' Association, September, 1922.
[2] *I.S.J.*, 1922, 219, 560.

the near future. The alcohol has a concentration of 90–92 per cent., this strength being preferred to 95 per cent., the small percentage of water which is converted into steam having a beneficial effect in a motor. The stove alcohol, made according to Formula 3 of the U.S. Treasury Department, has the following composition:—Alcohol, 100 gall.; ether, 5; kerosene, 2; and pyridine or aniline, 1 gall.

Thermal Values.

Motor fuel of the Foster formula has a thermal value of about 12,600 B.T.U. per lb., based on alcohol (of 90 per cent.), 11,000; ether, 16,200; and kerosene, 20,800 B.T.U. per lb. Ordinary gasolene has a value of about 20,700 B.T.U. per lb. On a 1 gall. basis, the alcohol motor fuel contains about 83,000 B.T.U. compared with about 130,000 for gasoline. The ratio of the thermal value of alcohol motor fuel of this formula to that of gasoline (by volume) is then 1·57.

In the case of the stove alcohol made by Formula 3, the thermal value is about 11,500 B.T.U. per lb., while that of kerosene is 20,800. One gall. contains 79,700 B.T.U. against 143,000 B.T.U. for kerosene. Here the thermal ratio is 1·795.

Operating Costs for 1000-gallon Distillery.

A recent estimate of the cost of erecting a distillery for the production of alcohol and ether capable of producing 1000 gall. of industrial alcohol per day, or 300,000 gall. per year of 300 working days was $61,200, or 2·448 cents per gall. at 12 per cent. interest and depreciation. The cost of manufacture, not including the value of molasses, has been found at Paia to be as follows:—

	Per 1000 gall.	Per gall.
	$	$
Supervision and labour	20·00	0·020
Fuel	20·00	0·020
Pyridine (10 gall.)	15·00	0·015
Kerosene (20 gall.)	4·00	0·004
Acid and lime	2·00	0·002
Interest and depreciation (12 per cent. on $61,200)	24·48	0·0245
Patent royalty	10,00	0·010
Incidentals	5·00	0·005
	$100·48	$0·1005

Hence the cost of manufacture per gall. is 10 cents, but some difference exists between the cost of making motor and stove alcohol, owing to the lesser percentage of ether in the latter, as stated elsewhere in this report. It takes about 1·3 gall. of alcohol to make 1 gall. of ether. Extra steam for the ether still is required; in addition to which there is the expense of renewing the lead coils of the apparatus. We believe that we are justified in stating that the cost of making the motor fuel is 20–30 per cent. greater. At a cost of 10 per cent. for industrial alcohol, we should be inclined to place that of motor alcohol at 10–11 cents, and that of stove alcohol at 8–9 cents per gall., a value for molasses not being included.

Value of Molasses as Raw Material.

When molasses is thown away, it might be entered on the estimates as of no value. But it has a potential value as a fuel and as a stock food, so that it is not possible to regard this raw material as a waste product in considering a proposition, the success of which will depend on returns covering a number of years. In the following table it is shown that as the value of molasses varies between $1·00 and $6·00 per ton, so the cost of manufacturing motor fuel must be increased.

Value of Molasses per ton.	Value of Molasses entering into each gallon of Alcohol.	Cost of producing Alcohol (Molasses value plus M'fg. Cost[1]) Motor.	Stove.	Value of Motor Alcohol equivalent to 1 gall. of Gasolene (Factor, 1·4)	Value of Stove Alcohol equivalent to 1 gall. Kerosene (Factor, 1·75)
1·00	1·67	11·67	9·67	16·34	16·92
2·00	3·33	13·33	11·33	18·66	19·83
3·00	5·00	15·00	13·00	21·00	22·75
4·00	6·67	16·67	14·67	23·34	25·67
5·00	8·33	18·33	16·33	25·66	28·58
6·00	10·00	20·00	18·00	28·00	31·50

Another method is to calculate the realization possible for the molasses when it is converted into industrial alcohol and substituted for competing oil fuels, and this can be calculated by the following formula:—

$$R = \frac{YK}{f} - YA = Y\left(\frac{K}{f} - A\right)$$

in which R = the realization for the molasses in dollars per ton; Y = the yield of industrial alcohol in gallons per ton of molasses; K = the price of gasoline or kerosene in dollars per gallon; f = a factor for converting gasoline or kerosene into alcohol (this varying from 1 to 1·5 and sometimes 2·0); and A = the cost of manufacture of the industrial alcohol in dollars per gallon. Thus, for example, if 60 gallons of alcohol are produced per ton of molasses at a cost of manufacture of 10 cents a gallon; and if it takes 1·5 gallons of alcohol to equal 1 of gasoline; and if gasoline is selling for 25 cents per gallon, then the realization value for the molasses is $4 per ton.

THE PLANT AT PAIA.

This plant, which started in a small way several years ago, has been reconstructed and enlarged from time to time to allow for improvements and increased capacity. At the present time, it has a capacity of about 1300 gallons of alcohol per day; and is producing from 500 to 1200 gallons of finished product daily, the amount depending usually on whether the still house is run 12 hours or 24 hours per day.

It consists of: (1) The fermenting house; (2) the still house containing the alcohol still and ether generator; (3) the denaturing house, containing receiving tanks for the alcohol before denaturing, a room for storing denaturants and the denaturing room; and (4) the warehouse for finished products.

Fermenting house.—The fermenting house contains a molasses supply tank of about 2500 gallons; a 5-ton Howe scale for weighing molasses; and a mixing tank of about 4500 gallons, having a perforated pipe in the bottom for mixing molasses and water with compressed air. The fermenting tanks until recently have consisted of 12 redwood tanks of about 3000 gallons each. These are being replaced with three wooden tanks of 20,000 gallons each. There are two yeast tanks of 3000 gallons, and one small yeast tank holding 500 gallons. To transport the diluted molasses to the fermenting tanks, and also beer to the still, there are two small Worthington steam pumps, 4½ in. × 2¾ in. × 4 in. One only is used, the other being a stand-by. There is a small compressed air pump and air tank. Compressed air, besides being employed for mixing molasses with water for the mash, is used for transporting the denaturants, and also for transferring the denatured alcohol from the denaturing house to the warehouse.

Still house.—The still house contains the alcohol still and ether generator, the former being of the Foster-Misener type and constructed entirely of redwood. This still apparently has several features to recommend it as being preferable to

[1] Cost of manufacturing motor alcohol 10 cents; and stove alcohol, 8 cents per gallon.

a copper apparatus. Due to the lower cost of material entering into construction, the first cost is considerably less. The labour of erecting is small, as the usual plantation carpenters can do all the work. It is economical in operation, and the wood construction acts as a very good insulating material in preventing heat losses by radiation. No man-holes are required in a wood still, as scale does not form on wood. As the product is not a beverage alcohol, no attempt is made to obtain quality, and an alcohol of 90 per cent. to 92 per cent. has been found to give better results as motor fuel than one of higher strength, so that *quantity* production is the essential item. The lees from this still contain only a small fraction of a per cent. of alcohol.

The ether generator is also of Foster design. This consists of a lead-lined receptacle containing sulphuric acid heated with lead steam coils. There is connected to this a save-all, scrubber, doubler and condenser. The ether receiving tank is of 1300 gallons capacity.

Denaturing house.—Alcohol from the still house flows by gravity to the denaturing house into either of two storage tanks, one of 1200 and the other of 1000 gallons capacity. A separate room contains the denaturants in drums which are emptied by compressed air into small measuring tanks. The denaturing room contains a 5 ton Howe scale with a 1000 gallon tank into which a certain amount of alcohol and denaturants are weighed by the Government Inspector when he is denaturing. Below the scale there is a receiving tank of 1000 gallons.

Warehouse.—There are five drum-head redwood tanks of about 2000 gallons each, together with a few small steel tanks for the storage of the finished product.

The Process at Paia.

Molasses of 84–85° Brix and 53–54 per cent. total sugars (after weighing) is diluted with water to about 20° Brix and 12 per cent. sugars. The mixture is pumped to a fermenting tank containing a sufficient quantity of yeast. Fermentation begins at once and is finished in about 24 hours. The alcohol in the "beer" runs from 6·5 to 7·25 per cent. The temperature increases to about 105° F. during fermentation.

The yeast which has been in use for several months started spontaneously in a tank of mash, without inoculation, and is to all appearances an indigenous yeast. It works as rapidly as any of many other yeasts tried, gives as high alcohol in the beer, and apparently overcomes all wild yeasts as fast as formed. No new pure cultures have been used since starting, which has now been nearly five months, so that the life of this remarkable yeast is unknown.

From the fermenting vats the beer is pumped to the alcohol still, the condensation from the head of which is conducted in three stages. Each stage consists of copper coils inside wooden tanks through which the alcohol vapours pass. The first is the doubler, as here the higher boiling vapours are condensed and pass back into the still. The coils in the doubler are immersed in water and the temperature control on the water in this tank governs the density of the alcohol produced. The vapours of lower boiling points are condensed in the second and third tanks and produce an alcohol of 186° to 188° which, after correction to the standard temperature of 60°F., equals 90 to 92 per cent. alcohol by volume. The coils in the second tank are cooled by incoming beer from the fermenting house which pre-heats the beer. Water is used to complete the condensation of alcohol vapours in the third tank. The beer is further heated before entering the still by passing through a heater which is heated by the lees after leaving the still pot. The lees are then run outside the still house and mixed with irrigation water.

The ether generator is fed by a portion of the alcohol produced in the alcohol still, which runs into a separate closed supply tank. The alcohol runs by gravity into the lead-lined pot of the ether still which contains strong sulphuric acid. A small amount of acid is added every few days. The pot is heated by lead steam coils. The ether vapours pass through a save-all and then through a scrubber. Through the scrubber is circulated a mixture of lime milk which frees the ether vapours from traces of sulphuric acid. The lime amounts to only a few lbs., added every third day. The ether vapours then pass through a doubler and a condenser, and next into the ether receiving tanks. The ether has a specific gravity of 0·727 to 0·73 and 1·3 gallons of alcohol are required to produce 1 of ether.

Lastly, the alcohol, except the portion for making ether, flows from the still house into receiving tanks in the denaturing house.

Yield.

For the sixteen weeks prior to visiting this plant in September, 1922, the records show a yield of 1 gallon of 90-92 per cent. alcohol to 2·55 gallons of molasses. The molasses was 84–83° Brix with 53–54 per cent. total sugars. The unfermentable sugar, according to a large number of tests made in 1921, amounted to 4 per cent., or about 2 per cent. on the weight of molasses. The theoretical yield after correcting for unfermentable sugars, and the small amount of organic acid, etc., necessarily formed, would be about 78 (U.S.) gallons of 90 to 92 per cent. alcohol per ton of molasses. At 2·55 gallons of molasses per gallon of alcohol, there are being recovered 65·5 gallons of alcohol per ton of molasses, or 84 per cent. of the theoretical amount.

Publications Received.

Annual Reports of the Progress of Applied Chemistry. Vol. VII; 1922. (Society of Chemical Industry, Central House, London, E.C.2.) Price: 7s. 6d., post-free to members of the Society; 12s. 6d., to non-members.

Vol. VII of the Annual Reports of the Society of Chemical Industry (dealing with 1922) has now been issued. It is unnecessary again to draw attention as in recent years[1] to the object of these Reports. Their value in enabling technologists specializing in a particular branch of industry to follow the trend of other branches of chemical activity is now generally recognised. This year the section on Sugars, Starches, and Gums is contributed by Mr. J. P. Ogilvie, who gives a general review of the work done in our industry, and deals particularly with developments in milling; recent efforts made by both chemists and engineers toward the improvement of the clarification process; methods of syrup filtration; the preparation, application, and revivification of decolorizing carbons, and their value as compared with bone char; and lastly new processes of beet juice extraction. Mr. H. J. Page, Chief Chemist at Rothamsted Experimental Station, has written a report on Soils and Fertilizers which should be read by all technologists desiring to keep abreast of progress made in agricultural chemistry. *Inter alia* it is mentioned in this report that the preparation of so-called "artificial farmyard manure" from the fermentation of straw[2] has now passed out of the laboratory stage, that a syndicate for the commercial exploitation of the process has been formed, and that the value of the material is being thoroughly tested on the practical scale. Since it is likely that a similar preparation can be made from bagasse[3] the progress made in developing this artificial farmyard manure is worth following. An industry somewhat closely allied to our own is that concerned with Fermentation, the annual progress in which branch has been reviewed by

[1] *I.S.J.*, 1920, 342; 1921, 223; 1922, 319. [2] *Ibid.*, 1922, 45. [3] *Ibid.*, 1922, 268.

Publications Received.

MR. H. LLOYD HIND. A point of potential interest in his pages refers to cellulose fermentation, as developed by H. LANGWELL, the patents relating to whose processes have been duly noticed in our columns.[1] Technologists concerned with the profitable utilization of bagasse, who are not impressed with the possibilities of its use as a raw material for paper making, might find it well worth while examining the question of cellulose fermentation, which very cheaply produces acetic acid and methane, from which latter product formaldehyde should be obtainable in good yield and at low price. It is probable that the McRae process would provide a means of separating from bagasse a product that is practically pure cellulose for the application of the Langwell process. At any rate this would appear to be a matter well worth looking into by chemists of cane factories producing an excess of bagasse.

Tölö Sockerbruks Historia, 1806-1918. [History of the Tölö Refinery, Helsingfors, Finland.] By Dr. Oscar Hackman. (Frenkellska Tryckeri Actiebolag, Helsingfors, Finland.) 1923.

This is an interesting sketch of the history of the Tölö sugar-house in Finland, showing its evolution from the most crude modes of working to modern methods, supervised by a strict chemical control. It is related that the turning point between empyrical and scientific operation came about 1880-1882, about which time the refinery was greatly troubled with such serious inversion that its yields were greatly diminished, a series of managers of the old school each failing to locate the source of difficulty. Ultimately, a technical man was installed as director, and quickly attributed the souring of the liquors to the state of the char, which had become quite deficient in calcium carbonate. Since that date the Tölö refinery has been conducted with a high degree of efficiency, and a notable feature of its later history has been its system of labour welfare, schemes for the housing of the work people, the formation of pension and sick funds and the like, having been successfully elaborated.

Optical Methods in Control and Research Laboratories. Vol. I. By J. N. Goldsmith, Ph.D., M.Sc., F.I.C.; S. Judd Lewis, D.Sc., F.I.C.; and F. Twyman, F. Inst. P. Second Edition. (Adam Hilger, Ltd., London, N.W. 1.) 1923. Price: 1s. 8d., post free.

This brochure has been compiled for the use of the works' chemist to serve as an introduction to the use of spectroscopes, spectrophotometers, refractrometers, and polarimeters; as a guide to their selection; and as an index to further sources of information so far as their employment in control and research laboratories is concerned. There are sections dealing with the polarimeter and the refractometer, both of which contain many useful notes regarding these instruments, their history and practical application. These sections are accompanied by references to original work, and are completed by a serviceable bibliography.

A Treatise on Weighing Machines. By George A. Owen. With 175 illustrations and plates. (Charles Griffin & Co., Ltd., London.) 1922.

Contents: Elementary principles of mechanics as applied to weighing machines. Definition of "weighing instrument." The beam, and the theoretical principles which it must satisfy. Friction: knife-edges and bearings. Types of beam scales. Counter machines. Steel yards. Dead-weight machines. Spring balances. Platform scales, and weigh-bridges. Self-indicating scales. Index.

Untersuchungen über Kohlenhydrate und Fermente. II. (1908-1919). By Emil Fischer. (Julius Springer, Berlin.) 1922.

Contents: Glucosides; acetyl-compounds; transformations of sugars; ferments.

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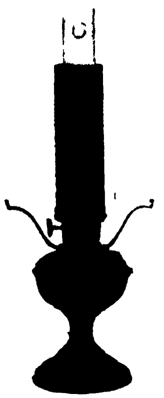
[1] *Ibid.*, 1921, 474.

A Powerful Incandescent Oil Lamp for the Illumination of the Polariscope.

White light for the illumination of the polariscope or saccharimeter may be furnished by lamps utilizing electricity, acetylene, coal gas, paraffin oil, or alcohol. Where electrical power is available, a 50 c.p. filament bulb gives a strong and steady light; while acetylene lamps are likewise satisfactory. But coal gas and paraffin oil yield a flame which is hardly bright enough for the illumination of a polariscope for all purposes in the sugar laboratory, as, for example, when one is examining molasses in the 200 mm. tube, or some other rather dark product in the 400 mm. tube. If, therefore, such lamps are to be used for the purpose in view, they must be provided with the Welsbach type of incandescent mantle. They then give a good white light, which can strongly be recommended for all general purposes in the sugar laboratory.

In the illustration is shown an excellent incandescent oil lamp, which has been so adapted as to form an efficient and economical source of light for the polariscope. It is of special design, and is free from the defects which have characterized other types, being simple in construction, incapable of explosion, clean and odourless, and free from oil and grease. It feeds the oil through a wick, and by mixing 6 per cent. of the vapour from the oil with 94 per cent. of air a blue flame which heats the mantle to a white glow is produced. In this way it gives a steady, pure white, light of 60 c.p.



As may be seen from the illustration, the domestic lamp has been adapted for the purpose in view by fitting it with a second chimney of metal outside the ordinary glass one, which outer chimney (capable of being readily detached, if it is desired to use the lamp for other purposes) has a small window of frosted glass serving for the diffusion of the light. This glass window can be immediately removed when required.

In fixing the lamp for use as a source of illumination in the polariscope cabinet, it is placed on a block of suitable height at the proper distance from the condensing lens of the instrument, or it may be secured by means of a bracket to a wall or suitable upright support. Chemists working in plantation laboratories should welcome a convenient, efficient, and economical lamp such as this for the illumination of their polariscopes.[1]

J. C. van der Meer Mohr[2] has described a series of experiments in both laboratory and field on the combating of the rat plague on Java plantations, in which encouraging results were obtained with asphyxiating gases. Carbon bisulphide, provided that for each hole 5-10 c.c. were used, and provided that a pump was used for forcing the gas up the gradients of the tunnelling, was found very effective; while acetylene[3] generated by the use of about 40 grms. of calcium carbide per hole gave equally good results in small scale experiments using artificial tunnelling, though in the field this gas for some reason not clearly established proved less satisfactory. On the whole, the conclusion is that further field trials are required before the value of these gases can decisively be pronounced; and in the meantime this investigator pins his faith to the systematic catching of the animals,[4] using bamboo *fuikjes* which are placed round the mouth of the hole, the rat being trapped by this contrivance.

A cane has been discovered[5] on the hacienda of Sr. Roberto Toledo, near Florida Blanca, Pampanga, which according to Dr. E. W. Brandes, Pathologist, of the Bureau of Agriculture, Washington, has so far proven to be immune to mosaic. Analysis of this cane shows a quality ratio of less than 9 to 1. It stools out very readily, attains a considerably greater height than local canes, and because of its dark green colour, can be discerned in any field. The identity of this cane is not stated.

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[1] It is obtainable from The Sugar Manufacturers' Supply Co., Ltd., of 2, St. Dunstan's Hill, London, E.C.3, who can deliver the lamp, provided with the special chimney and with spare mantles, suitably packed for export, promptly from stock.

[2] Meded. No 45, *Instituut voor Plantenziekten, Batavia.* [3] Meded. No. 55, *Instituut voor Plantenziekten, Batavia.* [4] Bulletin No. 16, *Instituut voor Plantenziekten, Batavia.* [5] *Sugar News*, 1923, 4, No. 2, 83.

Brevities.

Mr. George D. Luce, inventor of the cane harvesting machine, died in Los Angeles, Cal., on April 27th, 1923, at the age of 80 years.

Italy has temporarily abolished her Customs duty on sugar, in view doubtless of the fact that her home-grown beet sugar supplies are insufficient to meet demands till the next crop is harvested.

An exhibition of modern sugar machinery and appliances was held recently in Durban, Natal, under the auspices of the South African Sugar Association, at which British firms were well represented. It is probable that a similar exhibition will be held next year.

In drying sugar in a "granulator," a certain amount of dust is carried along with the air circulating through the apparatus, and various means have been devised for collecting this fine material. R. Vachier[1] now claims to have designed a machine of simple construction and of automatic action for collecting the dust, re-melting it, and returning it to the syrup tanks in the form of a concentrated syrup. It may be connected to any type of granulator. Details are not published.

It is reported that the manufacturers of "Natalite" have signed a six months contract for the supply of their motor fuel to the South African Railways for use throughout their motor transport services. It will be supplied at 1s. 4d. (about 31 cents) per gallon (Imperial), nett, f.o.r., in 5 and 40 gallon drums, which are returnable. The lowest tender for gasoline was 2s. 0½d. (about 47 cents) per gallon, f.o.r. at coast ports under bond, tins and cases to become the property of the railway company.

Coutant and Mariller[2] have found that 99.8 and 95 per cent. alcohol when exposed in open vessels to the atmosphere of a damp cellar at 15° C. gradually decreased in strength to 95·5 and 92·6 per cent. respectively after 21 days. In other experiments in which alcohol of different strengths was agitated or maintained at rest in motor spirit cans and other vessels for 19 days, the extent of the hydration was considerably less. In admixture with other fuels, such as petrol, alcohol is much more hygroscopic than in the pure state.

It is reported that Dr W. L. Owen, Bacteriologist to the Louisiana Sugar Experiment Station, has discovered a method for the prevention of the deterioration of raw sugar during storage. It depends on the inoculation of the raw sugar with a certain yeast (a torula) capable of acting only on the reducing sugars with the formation of carbon dioxide, the development of moulds, the causative agents in producing deterioration, being said to be prevented in this way. The method so far has been applied only on the small scale, but if Dr Owen is successful in adapting it for commercial utilization, a very considerable source of economic loss will be eliminated.

P. J. Bate[3] points out that the B.T.U. per gallon of petrol, benzol, and alcohol may very roughly be stated in the proportion of 14, 15 and 9 respectively, which figures are, of course, a measure of the relative amount of work obtainable from each fuel, though this is not all. In the first place, for complete combustion, the air to fuel ratios (by weight) are roughly as 15 to 13 to 9. This means that very much more alcohol may be used in one explosion than benzol or petrol. And in the second place, the relative latent heats are (again roughly) in the ratios of 12 to 16 to 40. The larger the latent heat, the lower the temperature of the mixture and consequently the greater the charge. These two factors enable one to get as much as 20 per cent. more power output from alcohol than from the other two fuels mentioned, but at a correspondingly increased consumption. There are other considerations of efficiency which have their smaller effects on the relative merits of the fuels, and it is sufficiently accurate to state that, when developing the same power output, alcohol fuel will entail a consumption, say, 30 per cent. greater than benzol and 20 per cent. greater than petrol.

1 *La. Planter*, 1923, **70**, No. 8, 150. 2 *Bull. Assoc. Chim. Sucr.*, 1923, **60**, 292-310.
3 *Chemistry and Industry*, 1923, **42**, No. 21, 522.

Review of Current Technical Literature.[1]

THE PETREE PROCESS, AS COMPARED WITH THE RETURN OF ORDINARY MUD TO THE MILLS. *G. C. Petree. La. Planter, 1923, 70, No. 15, 287-289.*

In his recent interesting article on "Hawaiian Practices in the Clarification of Cane Juice by Liming," Mr. McALLEP[2] mentioned that several factories in the Territory had attempted to return the mud from the settling tanks to the mills; and he concluded that: "It has been the general opinion that returning settlings to the mills will cause a decrease in the extraction." This result is not surprising, and it should go far towards convincing manufacturers that the return of *ordinary* mud cannot satisfactorily replace the filter-press station, but on the other hand will cause the extraction to fall considerably, and will produce an inferior clarified juice. The Petree process is an altogether different procedure in that it produces a *special* mud for return to the mills; and a few reasons for its success as distinct from such amateur attempts to replace filter-presses are as follows: (1) Individual clarification of the artificial, low purity, low density, secondary juice to which has previously been added the rich mud from the clarification of the high density mixed juices, so obtaining a clear secondary juice of increased purity before adding it to the high purity natural juice for further clarification; (2) the production of a special mud for applying to the bagasse in a juice vehicle which is low in quantity, as well as in sucrose content, and less rich in sugar than the residual juice in the bagasse at the point of admixture. This is secured by the double defecation of the low purity secondary juices, the first clarification of which was made by settling out the impurities from the low density artificial juice before adding this to the high density natural juices, and the use of the heavy previously gravitated rich mud as a "drag net" to further assist the precipitation of light floating and gummy or emulsified bodies in the low purity, low density, secondary juices; (3) the production of a special mud (built up in two distinct stages) which is more stable in its physical characteristics than mud obtained by simple defecation of the previously mixed natural and artificial juices. This special mud is more completely retained by the bagasse, and is not readily re-dissolved, in the stages of crushing following its application at the mills; (4) the substitution of the presses by a separate clarifying unit which provides the special mud for returning to the bagasse, this unit being distinct from the machinery used for clarifying the mixed juices; (5) a "trapped circuit" formed by the method of connecting the secondary clarifier with the milling plant, thus removing any chance of re-expressed mud obtaining access to the primary clarifier, and supplying clear juice to the boiling house.

Ordinary mud, containing anything from 10 to 25 per cent. of the total mixed juice, cannot be successfully returned to the mills, owing to the large amount of sugar placed on the bagasse for re-extraction by the plant, and owing to the large bulk of such ordinary mud bringing about a condition of bagasse saturation or flooding of the mill feed when added to the usual amount of maceration fluid. It was reported from Paahau factory when the ordinary mud was returned to the mills that the "settlings from the clarified juice were added in front of the third mill"; in other words, a large quantity of juice was returned in front of the third mill of a density equal to that of the juice from the first and second mills. Also that "the mill could not take the settlings as fast as they came from the clarifier"; but this was not because of the quantity of impurities, but because of the large amount of rich juice returned with them. Further, after settling "the juice was reported turbid and of a dark red colour"; but at Paia and Puunene, where the Petree process was installed last year, the factory superintendents and visitors stated they had never seen such perfect clarification. Then at Lihue and Kahuku factories where the return of ordinary mud was also attempted, the weekly figures showed "a steady decrease in extraction during this period"; whereas there is absolutely no reason why the Petree process should bring about a drop in the extraction as compared with the usual procedure, if the same total dilution of the juice (due to maceration and washing and diluting the mud at the press station) is made, unless unusual quantities of cush-cush or fine *bagacillo* are returned to the clarifiers as the result of the imperfect screening of the juice at the mills. With *ordinary* defecation the muds contain (as stated) anything from 10 to 25 per cent. of

[2] *I.S.J.*, 1923, 208. See also U.K. Patent, 189,817; *I.S.J.*, 1923, 105.

the total juice; while with the Petree process using the Dorr clarifier the figure is only about 5 per cent., and often less. At Puunene with the Petree process it has been found that cleaner juices and cleaner sugar were obtained, although previously the whole of the juices from the settling tanks has been filtered through cloth, and the muds, of course, also passed into presses, besides which an increased recovery of 1·3 per cent. was recorded as compared to the figures for the corresponding period in the preceding year, in spite of the mill extraction having dropped slightly. Regarding the work at Paia with the Petree process, the factory superintendent, Mr. J. P. Foster, stated that: "We expect to finish our crop with a net gain of over 1 per cent. additional recovery. The clarification is the most perfect that I have ever seen and the purity of the syrup closely approximates that of the first mill juice, whereas an average of the previous eight years' operation shows a syrup purity 2·8° below that of the first mill juice."

Boiler-house Installation of the Baltimore Refinery. *E. B. Powell.*[1] *Facts about Sugar, 1922, 15, No. 23, 458-461.*

As the most suitable capacity for present requirements to be installed, 6000 rated boiler h.p. was decided upon, and 9600 b.h.p. as the probable ultimate development. A grade of small-sized anthracite (known as "creek coal") was adopted as being the most satisfactory and economical generally, being not only low in price, but not subject to deterioration on storage, clean, and capable of being used also for the regenerating kilns. In selecting the type of boiler, consideration was given to the fact that the refinery type of load, while including a fairly large proportion of power of reasonably stable demand, is subject to relatively wide fluctuations, which may occur at any time of the day, as the vacuum pans are cut in or out, it being necessary for this reason to carry continuously in reserve sufficient steam generating capacity to take care of the maximum demand, though on the average this capacity is operated only at moderate ratings. Since it combines low first cost with very high efficiency at all moderate ratings, exceptional ease of inspection and maintenance, and (with the steam take-off from the rear drum, as here adopted) also remarkable freedom from tendency to prime under sudden heavy loads, the Stirling integral-economizer type boiler was selected. Also for the peculiar requirements of small-sized anthracite, this general type of boiler possesses over any other of approximately equivalent efficiency the added advantage of wider grate space, and of presenting to the furnace gases steeply inclined tubes. These boilers were 1200 b.h.p. units with 26 per cent. integral economizer surface, and were designed for 250 lbs. pressure for operating normally at about 210 lbs. pressure. They are equipped with 18-element mechanical soot blowers and with automatic feedwater regulators; while the building comprising the boiler-house is 111 ft. wide × 132 ft. long × about 125 ft. high with stacks 15 ft. diam. 200 ft. high above the roof, this building being of structural steel frame with brick walls and reinforced concrete flooring. Stokers are of the travelling grate type, two per boiler, each having an effective surface of 9 ft. 8⅝ in. wide × 16 ft. 4 in. long, giving a ratio of grate surface to heating surface of 1 : 38, and each being driven by a 2½–3 h.p. d.c. motor. Forced draught is supplied by three turbo-vane-type fans of 90,000 ft. per min. capacity at 5½ in. pressure, driven by 125 h.p. motors. Two electric tachometers are employed to indicate the grate speed, and meters recording steam output, rate of flow of air, and flue temperature are mounted immediately in front of several boiler units. In regard to the feed-water system, as practically all steam leaving the boiler-house and also that required for power purposes is condensed in closed coils, it is normally available for boiler feed purposes, hence the make-up requirements which have been estimated are only slightly greater than those of the modern condensing type electric generating station. To meet the accidental condition of coil leakage, or other cause of contamination or loss of condensate, however, provision has been made in the equipment for the emergency use of raw main water exclusively. Condensate returned to the boiler-house has a temperature of 180–220°F., and is first passed through standard towelling type filters to remove suspended impurities; while water from the mains is delivered first to a de-aerator capable of dealing with 24,000 lbs. per hour, in which all dissolved oxygen and other gases are removed.

[1] Consulting Engineer, Stone & Webster.

IMPORTANCE OF CLEANLINESS IN THE MILL. (1) *E. W. Kopke. Sugar News, 1923, 4, No. 2, 69.* (2) *A. W. Woods. Ibid., 1923, 4, No. 2, 70.* (3) *Editorial. Ibid., 1923, 4, No. 3, 101.*

Loss of sugar by inversion may occur in the cane factory to a greater extent than is ordinarily appreciated, and indeed under certain conditions may counteract the benefits of a higher extraction. A higher extraction is accompanied by a higher dilution, which means a juice of lower density, this being subject to inversion by fermentation to a greater degree than more concentrated liquids. Hence, in the Philippines considerable attention is being given to the sanitation of the crushing plant. Efforts are being made to avoid accumulations of slime in the juice pans below the rolls, the returner bars, mill cheeks, strainers, strainer slats and chains, and elsewhere, since such accumulations are sources of infection, inducing fermentation and consequently causing inversion. Engineers are being urged to make a thorough study of the question, and to apply such methods as may appear effective for removing any insanitary conditions. Frequent use of milk-of-lime and of formaldehyde (preferably by spraying), and the thorough steaming of all these surfaces (in some places by permanently fixed nozzles) is suggested as advantageous. Places demanding particular attention are the juice strainers, the slats of the cush-cush conveyors, and the pipes leading to the pump supply tanks. At the Hawaiian-Philippine Co.'s Central, live steam is being used every two hours on the strainers, and the slats of the cush-cush elevator are also steamed by means of a hose; while once a shift the mills are thoroughly treated with steam and hot water, special care being given to mill cheeks and other places where infection is liable to occur. As the result of such measures, it has already been noticed that the offensive odours arising from souring juices about the milling plant have been eliminated; and that also there has been a reduction in the differential between the purity of the crusher and the mixed juices. Thus, it is stated, that with an extraction of 96 per cent., the difference between the purity of the crusher juice and that of the mixed juice has occasionally been reduced to as low a figure as 1·0, largely, it is believed, to the improved conditions around the milling installation. Assuming that this improvement is solely due to this cause, it indicates the possibility of an increase in the recovery equivalent approximately to 100 tons of sugar in a 10,000 ton crop, as compared with average figures obtained with ordinary methods of working.

CONTROL OF THE LIMING OF THE RAW JUICE BY MEANS OF ITS HYDROGEN ION (pH) CONCENTRATION. *Javier Beobide. Sugar News, 1923, 4, No. 2, 65-68.*

After explaining the phenomenon of electrolytic dissociation or ionization, and after describing the methods which have been worked out for the determination of the hydrogen or hydroxyl ion concentration,[1] the author goes on to discuss the application of such principles to the liming of raw cane juice in the manufacture of raw and of white sugar. It is pointed out that for use in the colorimetric method there are now on the market preparations of acids and bases of known pH concentration (which solutions are contained in small vials with the proper indicators). In making a determination, the colour of the titrated solution containing the indicator of the desired pH range is compared with the standard solution of desired pH range. It is thus possible to titrate the unknown solution within 0·2 of the desired pH values, and this method can be used to ascertain the quantity of lime to be added to the mixed juice in the manufacture of raw sugar. Repeated experiments have demonstrated that a better clarification in respect of rapidity of settling, volume of precipitate, and clarity of the defecated juice is obtained with an acidity of from 0·2 to 0·4 per cent. using phenolphthalein, which acidity corresponds to a pH value between 6·8 and 7·0. The pH value of Brom Cresol Purple according to the table of indicators given in BREWSTER and RAINES' paper varies between 5·2 and 6·8, but Brom Cresol Purple is more sensitive and gives a sharper end point than phenolphthalein. It changes from yellow to purple, while the pH range for Phenol Red varies from 6·8 to 8·4 and changes from yellow to red. It will be noted that the pH value producing an intensive purple with Brom Cresol Purple, would only give a faint rose coloration with Phenol Red.

[1] See BREWSTER and RAINES, *I.S.J.*, 1923, 88-93.

By the use of these two indicators it should be possible to obtain accurately the most desirable point for the defecation of the mixed juice. The Brom Cresol Purple is prepared by dissolving 0·1 grm. of the dry powder in 3·7 c.c. of N/20 sodium hydroxide and diluting to 25 c.c.; while Phenol Red is prepared by dissolving the same amount in 5·7 c.c of N/20 sodium hydroxide and diluting to 25 c.c. with water. These are stock solutions. For use in the liming tank the stock solution of Brom Cresol Purple is diluted ten times, and that of Phenol Red twenty times, thus making them 0·04 per cent. and 0·02 per cent. solution respectively. Application is very simple; in a porcelain dish are mixed three or four drops of the mixed juice, and a drop of the solution of Brom Cresol Purple; when the solutions is intensely purple, it is treated with Phenol Red which ought to give a very faint rose colour. By varying the quantity of lime and juice, the proper point can be easily obtained. This procedure is as simple as with litmus paper, and is as much more exact and also more economical. Further, with the use of standard solutions, it is possible to control the acidity of the juice to any desired point.

HARMFUL INFLUENCE OF TRACES OF SUGAR ON CEMENT AND CONCRETE. *F. Hundeshagen*. *Zeitsch. angew. Chemie*, *1923*, *36*, *53–54*.

A concrete ceiling, built in the warehouse of a German beet sugar factory, failed to harden after five weeks. Laboratory experiments showed that only 0·1 per cent. of sugar in the cement (representing only 0·02 per cent. in the dry concrete) suffices to disturb the hardening process, and to lessen the strength of the mass when at length it hardens.

EVALUATION OF DECOLORIZING CARBONS (AND SOME CONSIDERATIONS ON THE MEASUREMENT OF COLOUR). *Marshall T. Sanders*.[1] *Chemical and Metallurgical Engineering*, *1923*, *28*, *541–542*.

In certain of the methods at present used for the evaluation of decolorizing carbons, boneblack or some other decolorizing carbon is selected as a standard, and the preparation under examination is stated to be so many times more or less efficient. Sometimes the preparation is rated on its "decolorizing power," depending on the percentage of colour removed by a given quantity of carbon from a certain solution; while again a process may be adopted according to which the amount of dye which can be added to an aqueous suspension of the carbon without colouring the water is ascertained. But such methods (as generally carried out) are fallacious, because "a straight line cannot be determined by one point, nor is one equation with two unknowns capable of definite solution." Decolorization is an adsorption phenomenon, and the empirical equation most widely used in relation to experimental data dealing with adsorption is that proposed by FREUNDLICH: $\frac{X}{M} = kC^{\frac{1}{n}}$, where X is the amount of solute adsorbed by M grms. of the adsorbent, and C is the concentration of this material remaining in the solution at equilibrium. Both k and n are empirical constants, and any method for the evaluation of decolorizing carbon must take into consideration the fact of these two constants. Dr. F. W. ZERBAN[2] has found that by using the Meade-Harris colour units[3] in place of the concentration terms X and C in the above formula, straight lines for the plotted relations of the log $\frac{X}{M}$ to the log C are obtained. In place of the Meade-Harris values, in which equal weights were assigned to those representing red, green and blue violet light, the author has compiled a table in which the Meade-Harris units are weighted by the "luminosity" of each colour, which modified units are believed more closely to represent the colour of a solution as it affects the human eye than do the original ones. It is believed by the author that the determination of the colour removed by means of the Hess-Ives tintphotometer. and the use of the modified Meade-Harris units, will be found to constitute the basis of a satisfactory method for the evaluation of the effect of decolorizing carbons. As the constants k and n of the equation are for one particular colouring matter, and for one initial concentration of that colouring matter, the action of the various decolorizing carbons should be

[1] ATLAS POWDER CO., Wilmington, Del., U.S.A. [2] *I.S.J.*, 1921, 625. [3] *I.S.J.*, 1920, 332.

determined for the particular solution it is intended to treat, and there is no reason why the action of a carbon in the case of a given solution should be of itself any criterion for its action in any other. If the exponents $\frac{1}{n}$ for two carbons used in the decolorization of a certain solution are not identical, then the efficiency of the two preparations will vary with the colour of the solution after decolorization. Summarizing what has been stated, it has been shown that the present methods followed for the comparison of decolorizing carbons are fallacious, because they fail to take into account two factors. All carbons do not act similarly on different solutions, and so the action of these preparations being an adsorption phenomenon must follow the adsorption equation.

APPLICATION OF "CARBORAFFIN" IN THE REFINERY ON THE LARGE SCALE. *Hermann Lustig. Zeitsch. Zuckerind. czechoslov. Republik, 1923, 47 (iv), No. 23, 316-318.*

During the 1919-20 and 1920-21 campaigns "Carboraffin" was used in the Göding refinery in Slovakia for the treatment of the first claircе, bonechar still being employed for the second liquors; while during the following two seasons decolorizing carbon exclusively was applied. Particulars are given in this article of the procedure followed. About 2300 quintals (226 tons) of raw sugar were melted daily, and worked at a density of 60° Brix, about 2450 hectolitres (54,000 galls.) of first clairce, and about 1500 hectolitres (33,000 galls.) of second being treated. 12 Danek filters were used, each having a surface of 23 sq. m. (248 sq. ft.), but provided with 23 frames only (so as to make room for a thick cake of carbon), the procedure being to make a suspension of the carbon in water by blowing steam through a mixture of about 60 kg. (132 lbs.) of the "Carboraffin" in five hectolitres (110 gallons) of water; to render the suspension distinctly alkaline (to phenolphthalein) with milk-of-lime; to further add about eight hectolitres (176 gallons) of some filtered clairce; and then to pump this into the filter until cakes having a thickness of about 20 mm. (nearly ⅞ in.) had formed. Then first clairce at a temperature of 80-85° C., and a density of 60° Brix, was pumped through the carbon. During the first 3-4 hours, it ran through almost water-white; later it gradually coloured, until after 12 hours it ran through at 1° Stammer (calculated up to 100 parts of sugar), and after 24 hours the degree of colour had reached 2·2°. At this time it was found that the rate of flow was diminishing, owing to the formation of a slimy layer[1] on the surface of the carbon; and so the cakes were dropped down, mixed up with water, again pumped into the Daneks, and another series of cakes thus prepared with the same lot of carbon. Filtration with first clairce was resumed, when it was seen that the rate of filtration was practically the same as before, though the decolorization was less. However, for a time the liquor ran through water-white, and after 12 hours the colour was 1·5° S., after 24 hours reaching 2·2° S. Once again the carbon cakes were re-formed as before, and although during the third day the effect had diminished somewhat, yet it was possible to obtain a sufficient decolorization. On the fourth day, after the carbon cakes had once again been re-formed, second clairce was switched on; it was run for 24 hours; the cakes were re-formed; and second clairce was passed through for another 48 hours. After this the carbon was deemed exhausted. It was therefore dumped into water; the black suspension pumped into a small filter-press, washed with water down to a sugar content of 0·1 per cent., and then rejected from the process without revivification. Thus the same lot of carbon had been used 72 hours for the filtration of first clairce, and 48 hours for that of the second. Each filter required 65 kg. (143 lbs.) of fresh carbon, which calculated on the amount of raw sugar melted is 0·071 per cent., while the rate of flow for the first clairce at 60° Brix was 23-30 hectolitres (500-600 gallons) per hour, and for the second clairce at 56-58° Brix, about 17-22 hectolitres (374-484 gallons). After the decolorizing treatment, the claircеs were passed through a set of Daneks as a precautionary measure to ensure the absence of any carbon particles, the first being subsequently boiled to loaves and cubes, and the second to "pilé," "crystal," and "meal," and in no instance was the quality of

[1] See also *I.S.J.*, 1921, 106, 402; 1922, 154, 318.

these inferior in any way to that ordinarily obtained in bonechar work. Carbon application in the refinery involves no practical difficulty, it is said; and presents distinct advantages as compared with bonechar; such as, more rapid operation, much less sweet-water, and a lower loss of sucrose. Three workers only were required per shift in this refinery in the decolorization department; and it is calculated that the total cost of applying "Carboraffin" in this small sugar-house in the manner described amounted to about Kc. 2·0 per 100 kg. of white sugar produced.[1]

DETERMINATION OF THE ASH OF SUGAR PRODUCTS (SYRUPS AND MOLASSES). (1) *J. F. Brewster.* *Journal of the Association of Official Agricultural Chemists, 1923, 6, No. 3, 365-369.* (2) *W. L. O. Whaley. Ibid., 1923, 6, No. 3, 370 373.*

(*1*) Dr. F. W. ZERBAN, as Associate Referee on Sugar-house Products of the A.O.A.C., reported in 1916 on the results of co-operative work on the determination of ash in syrups and molasses, using three official methods, viz., I, direct incineration; II, carbonization, removal of the soluble salts by leaching out, incineration of the carbon, and evaporation of the solution; and III, sulphation, as generally applied at the present time. He found that Method I may give results differing widely from those shown by Method II; that Method II had no advantage over Method I: and that Method III has no advantage over Method I from the standpoint of close agreement among different analysts, or from that of ease of manipulation. This work is now taken up by Mr. BREWSTER, the present Referee, in collaboration with four analysts, who in due course reported the results of applying the three methods at temperatures of 475, 500, 525, and 550°C. to various samples of syrups and molasses. In regard to Methods I and II, it was found that an increased temperature showed a tendency to give a decreased ash, the results obtained in the case of a first molasses by one of the analysts at the four temperatures named being, for example, 4·90, 4·76, and 4·68 per cent. These two methods yield results the difference between which is negligible; in fact in only 15 out of 33 cases was the carbonated ash higher than the direct ash, and then the differences were only slight. Since ashing at the lower temperatures requires practically no more time than at the higher ones, provided the air supply is adequate, 475°C. ("incipient red heat") up to 500° C. ("distant dull red heat") are the degrees of heating which are recommended. Coming now to Method III, it was found that a very good agreement occurred in the results of all the analysts, though ZERBAN had not found this to be so. Regarding the temperature used, this makes practically no difference in the results, unless, perhaps, when silica dishes are employed in place of platinum. A series of tests of this method using dishes of the two materials named was made, when silica dishes were found to yield the lower results, for example, 2·24 as compared with 2·46, or 5·48 with 5·59, or 9·07 with 9·35 per cent., so that it would seem advisable to recommend the use of platinum dishes. Regarding the factor to be applied in the sulphation method, instead of 10 per cent., one of 16 for syrup and of 19 for molasses, were found to obtain. It is recommended by this Referee that Method I be given official preference for the determination of ash in cane syrups and molasses; that Method II be used only when it is found impossible to get a carbon-free ash by the shorter method; and that Method III, the sulphation method, be discontinued as an official method (though it must be remarked that the reasons leading to the last decision are not altogether clear). (*2*) In this second paper, the results of determinations of direct incineration method in nickel as compared with platinum dishes are recorded. Advantages claimed in favour of the cheaper metal are that results as concordant as with platinum are obtained; and that incineration is effected more rapidly than in platinum or in silica dishes. In fact this analyst says that nickel dishes are far superior to dishes made of fused silica for work of this kind, and cost only about two-thirds as much.

J. P. O.

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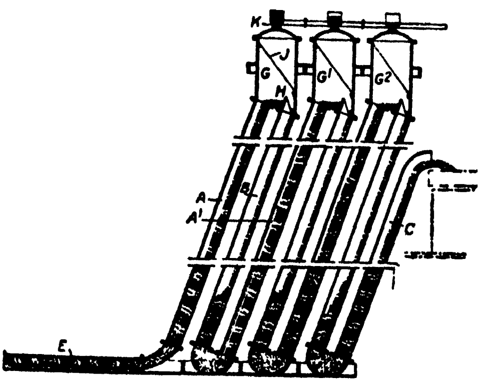
[1] With the present exchange at the rate of 158 Czecho-Slovakian kronen to the £ sterling, this would be equivalent to about 2s. 6d. (or about 59 cents) per ton of 1000 kg., which, considering that revivification was not applied, is certainly a very low cost.—Ed., *I.S.J.*

Review of Recent Patents.[1]

UNITED KINGDOM.

APPARATUS FOR USE IN THE HIGH TEMPERATURE CLARIFICATION OF CANE JUICES. *Duncan Stewart & Co., Ltd.*, of London Road Iron Works, Glasgow, Scotland (communicated by *Wilhelm Mauss*, of Johannesburg, Union of South Africa). *194,948.* April 3rd, 1922.

This invention has for its object to provide for use in what is known as the high temperature system for the clarification of sugar and other juices, solutions and the like, containing albumen (vegetable or animal) or other matters coagulable by heat, an improved and simple apparatus for that necessary gradual reduction of temperature and pressure which is the final step of the process. Apparatus made according to the invention is devised with an especial view to the avoidance of the breaking up of the particles of albuminous and like matters which have become coagulated during the heat and pressure treatment. If these particles have to pass through narrow apertures at high velocity, or if the liquid carrying them be violently agitated, they are apt to be disintegrated. In the finely divided state so produced, they clog the filtering surfaces through which the liquid is afterwards passed. An apparatus in which the particle-bearing liquid at no time passes through restricted apertures, nor is subjected to violent agitation, comprises essentially a series of pressure and temperature reducing units each consisting of a pair of tubular elements, an upcomer and a downcomer, inclined at an angle to the vertical. The angle at which the upcomer lies is such that steam and vapour, released from the column of liquid rising in the tube element, and owing to its so rising undergoing a reduction of pressure, tend to collect at the upper side of the element. Similarly, the liquid delivered from the upper end of the upcomer tends to flow down the lower side of the downcomer. The upper ends of the upcomer and downcomer are collected in a vessel into which liquid is discharged from the upcomer and from which it flows to the downcomer. In this vessel are baffles and separating devices, and in it is maintained, under the control of a loaded relief valve, a pressure less than that at which the liquid is delivered to the lower end of the upcomer by the amount due to the vertical height of the column of liquid in the upcomer. The lower end of the downcomer of the first unit is connected with the lower end of the upcomer of the second unit. This second upcomer debouches into a second vessel connecting it with the second downcomer, and in this vessel is maintained a pressure less than the pressure in the first vessel by the amount due to the vertical height of the column of liquid in the second upcomer, or substantially so, but such that a seal is maintained at the connexion between the lower end of the first downcomer and the lower end of the second upcomer. The second downcomer may communicate with the upcomer of a third unit and so on for any number of units. In this way the pressure of the liquid is reduced step by step (in degree in accordance with the number of units) until finally it is discharged (to the vacuum filters or elsewhere) by a short upcomer in which the pressure is finally reduced to atmospheric.



[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Turning to the example of the invention illustrated in the drawing, it is seen that the hot liquid passes from a pipe *E* up a pipe *A* to a chamber *G* provided with a loaded relief valve *K* which maintains a pressure in the chamber less than that in the pipe *E* by that due to a column of the liquid of the height of the pipe *A*. The pipe *A* is inclined to facilitate escape of vapour as it is generated. The liquid is separated from the vapour in the chamber *G* by a perforated baffle *J* and passes over a weir *H* down an inclined pipe *B* whence it passes up an inclined pipe A^1 to a second chamber G^1, the pressure in which is less than that in the chamber *G* by an amount just sufficient to maintain a liquid seal at the junction of the pipes *B* and A^1. From the chamber G^1 the liquid passes at decreasing pressures through another chamber G^2 or a series of such chambers connected to the chamber G^1 and to each other in a manner similar to that already described and escapes through an upcast pipe *C*.

Use of Carbon Black for the Decolorizing Sugar Solutions. *Alex. C. Cumming and Klarit, Ltd.*, of Litherland, Liverpool. *196,002.* October 14th, 1921. (No drawings; five claims.)

Hitherto it has been proposed to use bone charcoal or decolorizing carbons as "Carboraffin" "Norit" "Eponit," or the like, for the decolorization and purification of impure sugar products, and of other liquids in various branches of chemical industry, e.g. that of oil and fats. But the present invention depends on the discovery that carbon black is excellently suitable for this purpose, provided that it is substantially free from oil. In such cases, the material has excellent decolorizing properties, and can be readily filtered from the solution in spite of its very fine state of division. By the term "carbon black," is understood a well-known commercial product, which is manufactured at present for use in rubber manufacture and for lithographic inks or for other purposes, of the quality termed "genuine American carbon black." This is made by the decomposition or incomplete combustion of gaseous hydrocarbons having a high percentage of hydrogen, such as natural gas. Many samples of commercial carbon black contain sufficient oil to make them entirely unsuitable. The small amount of oil necessary to produce a deleterious effect may be illustrated by the fact that the decolorizing power of carbon black is considerably reduced if even 1 per cent. of lamp black is incorporated therewith. Carbon black which is inactive or feebly active on account of the presence of oily matter may be made highly active by treatment to remove the oil. Heating for a short time to a red heat is a convenient and suitable method for effecting this; and the invention includes such a method of treating carbon black. The invention does not include the use of decolorizing carbons (made by incinerating vegetable material) or of lamp black (made by incomplete combustion of oil) or other forms of carbon except carbon black as defined above. Reference is made to Specification *25,671* of 1899, taken out by Ed. Pohl, of Kalk, near Cologne, who describes a filtering charcoal consisting of an intimate mixture of ordinary filtering material such as kieselguhr with solid carbon, this latter being produced by decomposing gaseous or liquid hydrocarbons at a glowing heat. By this invention, however, oil-free carbon black is produced by the decomposition of gaseous carbons having a high percentage of hydrogen. In regard to the method of application described by the inventor in the present patent specification, it is stated that the material is preferably used at low temperatures either for partial or complete clarification or decolorizing of liquids. It may also be used to assist filtration of a liquid containing finely divided solids. Since carbon black may be used either alone or mixed with other substances, such as china clay or kieselguhr, which may be so chosen as to improve the filtering qualities of the mixture, the invention also includes improved adsorptive compositions of this kind consisting of mixtures of oil-free carbon black with solid adsorptive inert filtering agents such as kieselguhr.

Liquid Meters. *Soc. Hardoll*, of Paris, France. *194,713.* March 9th, 1923; convention date, March 10th, 1922.

SLAKING CAUSTIC LIME FOR THE PRODUCTION OF MILK-OF-LIME. *N. V. S. Knibbs, and Denny Chemical Engineering Co., Ltd.*, of Salisbury House, London, E.C. 2. *192,278.* January 30th, 1922.

In the hydration of lime and similar reactions between a solid and a liquid the variation in temperature of the reaction-mass is utilized to vary the rate at which one of the reacting materials, usually the liquid, is supplied. Lime entering the trough *1* from the conveyer *6* is treated with water delivered from the pipe *7* in such amount that the initial product contains an excess of lime, an auxiliary supply of water being then introduced from the sprinklers *11* at a rate which is made to vary with the temperature of the reacting mass. This is effected by means of a device comprising two rods *12*, Fig. 5, of different metals. One rod is rigidly secured at one end to the end-plate *13* of the trough *1* and at its other end to the adjacent end of the companion rod, the free end of which passes through a gland *14* and is connected through a coupling with the rod *16*. The rod *16* is adjacent to the perforated spindle *18*, Fig. 3, which communicates with the chamber *22* to which water is supplied through the pipe *23* and needle-valve *30*. Water discharges through the outlet *34* at a rate which varies with the distance between the adjacent ends of the rod *16* and spindle *18*, and the resultant pressure in the chamber *22* acts by way of the duct *37* on a diaphragm or like device to control the supply of liquid to the sprinklers *11*, the supply increasing with the temperature of the reaction-mass. The spindle *18* is engaged in the support *20* by an external screw-thread, by means of which the supply of liquid to the sprinklers may be varied independently. The hydration of lime is preferably carried out at a relatively high temperature, an excess of water being used to ensure complete hydration.

FIG. 3.

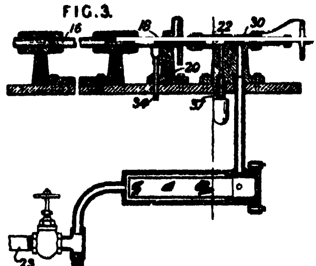


FIG. 5.

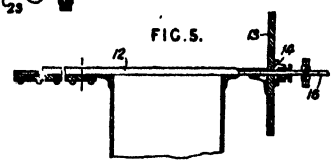
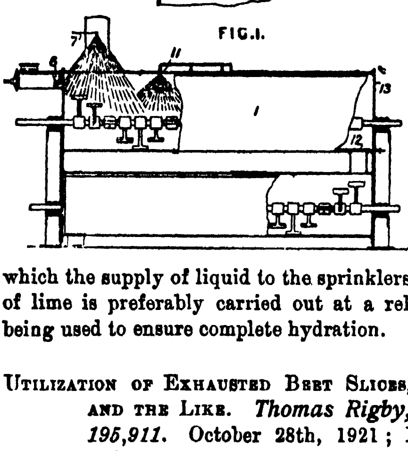


FIG. 1.



UTILIZATION OF EXHAUSTED BEET SLICES, WASTE DISTILLERY AND BREWERY GRAINS, AND THE LIKE. *Thomas Rigby*, of 72, Victoria Street, Westminster, S.W. 1. *195,911.* October 28th, 1921; November 17th, 1921. (No drawings; four claims.)

It is explained in this specification that beet slices, and waste distillery and brewery grains, are usually heavily charged with liquid, and may also be slimy, and that therefore their economical drying to render them available for use as cattle food and other purposes is a serious problem Claim is made for a process comprising slicing or crushing these materials, extracting them with water to provide a sugar solution for brewing or distilling, and then drying the solid residue by means of an apparatus described in the inventor's Specifications 180,963,[1] 181,035, and Boberg's specification, 149,056, wherein vapour evolved from the material being dried as a film upon a heating surface is utilized to effect further heating for film drying. In order to render the residue apt for distribution as a thin uniform film on the heating surface of such a dryer, it is either pulped (which further sub-divides the slices or crushed grains) until it attains the requisite semi-fluidity, or else it is mixed with an agglutinant. Or a combination of these measures may be applied.

[1] *I.S J.*, 1923, 109.

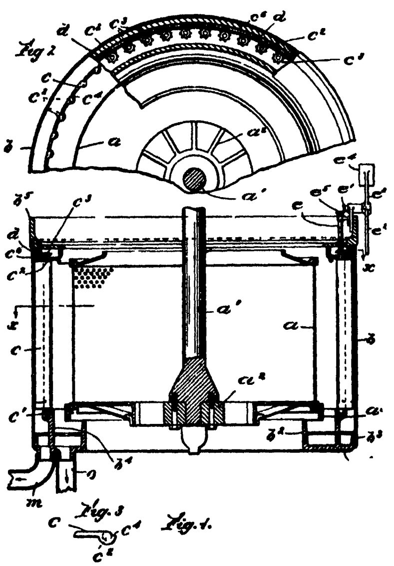
Active (Decolorizing) Carbon. *Farbenfabriken vorm. F. Bayer & Co.*, of Leverkrusen, near Cologne, Germany. *195,390.* March 21st, 1923; convention date, March 22nd, 1922.

Active charcoal is manufactured by finely grinding peat or lignite, impregnating with a solution of a salt such as ferric chloride or of an acid, for example phosphoric acid, and agglomerating by pressure so that after carbonization, pieces of well-defined shape result. In an example, impregnation takes place in a kneading machine, and agglomeration by extrusion through a thread press using 2 mm. dies. The mass is then dried in a rotary furnace, and carbonized in a muffle furnace.

UNITED STATES.

Centrifugal Machine provided with Means for the Separation of the Molasses from the Wash-liquors. *Eugene Roberts*, of Salt Lake City, Utah (assignor to the *Western States Machine Co.*, also of Salt Lake City, Utah, U.S.A.). *1,441,751.* January 9th, 1923. (Three figures; and three claims.)

It is intended to provide a simple means for the separation of the molasses (so-called "green juice") from the wash-syrups or liquors that are successively swung out during the centrifuging of massecuite; and the means consists primarily in the combination with a centrifugal basket of any suitable type with a surrounding curb or casing provided with movable deflecting means which are shiftable to deflect the extracted liquid into an inner passage and which in another position of adjustment allow the extracted juice to escape into an outer passage. In the practice of the invention according to the form illustrated in the drawings, any suitable type of perforated centrifugal basket a is carried by a central rotary shaft a' to which it is fastened by means of the usual spider a^1. Surrounding this basket is the cylindrical casing or curb b provided with an upper rim b^5 and a lower or trough member b' the latter having an outside flange b^3 and an inside flange b^2 as is usual to form an annular trough for the collection of the liquid extracted from the basket contents and discharged from the basket by centrifugal force. In this case the trough b' is provided intermediate of its outer and inner flanges with a flange or partition b^4 which divides the trough into outer and inner compartments or passages. The inner passage discharges into an off-take pipe o and the outer passage into an off-take pipe m leading to different receptacles. Above the partition b^4 is located the deflecting means which in this case comprise a series of blades or shutters c provided at their lower ends with pivotal journals c' resting in sockets in the top of the partition flange b^4, and at their upper ends with pivotal journals c^2 seated in bearing openings formed in a ring c^3 attached to or forming part of the top rim of the casing. These shutters are arranged in a circumferential series with the blade of one shutter overlapping the adjacent end of the next one when the shutters are enclosed or in circumferential position for deflecting or arresting the outward movement of the extracted juice. To make the joints tight the thickened end of each blade is cut away to form a shoulder c^4 so arranged as to receive the free or projecting end blade as shown in Fig. 2.

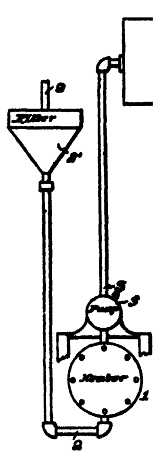


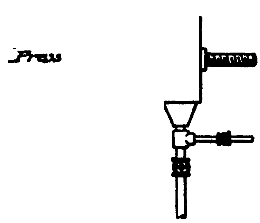
In the form shown in the drawings the deflecting means are shifted to inoperative position by moving the individual shutters from circumferential to radial position, thereby

leaving a wide space between the adjacent shutters to permit the discharge of juice outward against the outside wall of casing *b*. For effecting this shifting movement any suitable mechanism may be employed. In this case a series of gears or pinions is shown secured to the upper ends c^2 of the blades or shutters *c* and a sprocket *d* encircling these series of pinions c^3 in engagement therewith, so that the circumferential movement of the sprocket chain in either direction will correspondingly rotate the pinions and their connected shutters. For convenience in operating and maintaining the shutters in their position of adjustment an arm or lever s^2 is provided, to whose upper end s^3 is attached a weight s^4. Said lever is mounted on a horizontal shaft to which is fixed a bevel gear s' meshing with its companion bevel gear s^5 on a shaft *s* which forms an upward extension of one of the shutters *c*. It will be seen that if this weight arm is thrown to one side, it acts through the medium of the bevel gears and the shaft *s* and sprocket chain *d* to shift the whole series of shutters collectively or simultaneously into circumferential or closed position. The shifting of the weight arm in the opposite direction acts similarly to shift the shutters into radial or open position in which position the centrifugally moving juice passes between the shutters into the outer compartment and then through the off-take passage *m*. In order to prevent the swinging or gyrating basket from impinging against the shutters and causing damage, secured to the bottom of the basket, a peripheral ring a^5 is provided, which by striking against the partition b^4 or the inner flange b^2 as the case may be, limits the gyration of the basket and prevents it from striking against the juice deflecting means.

PROCESS FOR THE CLARIFICATION OF CANE JUICE, AND ITS ENTIRE FILTRATION. *Carl J. G. Sörensen*, of St. Croix, Virgin Islands. *1,448,421*. March 13th, 1923. (One figure; seven claims.)

Clarification can be accomplished more thoroughly, as well as more economically and expeditiously, if substantially all of the fine cane fibres, commonly termed *bagacillo*, are retained in the juice, and if the juice containing the same is heated in a closed vessel, and is then conducted immediately, without exposure to the external atmosphere, into a closed filter, such heating and filtering operations being conducted under such conditions that the temperature of the liquid, particularly during the heating operation, is in excess of the boiling point thereof. In the drawing is shown a diagrammatic view of an apparatus suitable for carrying out the invention, the same comprising a digester or heater *1* having an inlet *2* and outlet *3*, which latter communicates directly with a pressure filter-press *4*. Raw cane juice, in the original condition in which it is extracted, is first strained through a coarse strainer, for example a plate strainer having about 225 apertures to the square inch, each from 0·03 in. to 0·04 in. in diameter, in order to remove coarse material therefrom without appreciably removing the fine fibrous cane particles, i.e., the *bagacillo*. The acidity of the juice is then neutralized by tempering with the requisite quantity of milk-of-lime (or other alkaline reagent), while constantly agitating the liquid with air in order to effect thorough neutralization of the entire mass, and the intimate admixture of the solid and liquid portions thereof. The thoroughly mixed and neutralized juice is pumped (or otherwise conducted) into an autoclave heater, wherein it is subjected to sufficient pressure relative to the boiling point of the liquid at the pressure of operation to prevent the boiling and frothing thereof. For ordinary juice, which boils at atmospheric pressure at less than 101°C., a pressure is maintained higher than that corresponding to a boiling point of





102°C.; and the inventor has found that with a pressure of 40 lbs. per sq. in. excellent results are obtained if the temperature of the juice in the heater is raised to between 108° and 110°C. and the juice is caused to constantly flow through the heater en route to the filter. The temperature in the heater should in no event be below 70°C., the coagulating point of albuminous matter. From the heater the juice (still containing substantially all of the original *bagacillo*) is pumped directly through the filter, such for example as the ordinary plate-and-frame filter-press, preferably without exposure to the open air, and without substantially varying the pressure thereon, but in no event should the juice be allowed to settle in sedimentation tanks in accordance with the now common procedure, as it then becomes impossible to secure the beneficial results secured by this new method of treatment.

Filtered juice obtained in this way is of a highly desirable colour; boils readily; and is remarkably free from *bagacillo* and foreign impurities, giving ultimately prime, dry crystals, which are dense, hard, and of high purity, being especially low in ash, water, gum and insoluble matter. Among further advantages as compared with the present mode of operating are the following: (1) the time of treatment is considerably lessened, the storage capacity of the plant is notably reduced, and the re-heating of the juice is avoided; (2) *bagacillo*, together with the albumens and insoluble gums, constitutes a remarkably effective filtering medium, and permits the entire filtration of the juice; (3) the protection of the highly heated juice from prolonged exposure to the oxidizing action of the air greatly reduces any tendency to form difficultly removable coloured compounds, due either to caramelization or otherwise; (4) owing to the higher purity of the juice, there is an economy in the cost of cleaning the evaporators; (5) contrary to all expectations, it is possible when filtering all the juice to employ a very small filtering surface, viz., only 110 to 120 sq. ft. per metric ton of juice; (6) as may be determined by polarization tests, the deterioration of the raw sugar is minimized, even after long periods of storage; (7) owing to the high temperatures maintained, clarification and sterilization are very complete, whereby the keeping quality of the clarified juice is very materially increased. Claim 7 of this specification[1] reads thus: "The method of purifying impure sugar cane juice, which consists in subjecting such juice, while still containing a majority of the *bagacillo* that were normally present in the juice when in a freshly extracted state, to the neutralizing action of sufficient milk-of-lime to satisfy the acid reacting compounds in said juice, then heating the same to a temperature in excess of 105°C., while under a pressure sufficient to prevent ebullition of the juice and not less than 25 lbs. per sq. in. in excess of atmospheric heating such juice while the same is flowing, and then, without interrupting the flow of such juice, causing such juice to pass through a filtering medium which is substantially impervious to the *bagacillo* and readily permeable to the liquid juice, while still maintaining a pressure of at least 15 lbs. to the sq. in. in excess of atmospheric upon the juice during such filtration, and then recovering the resultant effluent juice."

ELECTRICALLY HEATED AND CONTROLLED STEAM BOILER. *William H. Rowe*, of Jacksonville, Ila., U.S.A. *1,451,847.* April 17th, 1921.

Claim is made for the following:—In an electrically heated boiler, a plurality of electric heating elements inserted in tubes, secured to the underside of the boiler, and projecting into it; a cylinder communicating by means of a pipe with the steam and space in the boiler; a piston and a piston rod free to move in said cylinder; a lever connecting said piston rod with an electric controller; and the heating elements connected by wires to said controller.

BEET PULLER. *Charles E. White*, of Moline, Ill., U.S.A. *1,451,725.* April 17th, 1923. BEET TOPPER. *Harry L. Sparks*, of Hunkman, Nebr., U.S.A. *1,450,872.* April 3rd, 1923.

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[1] Note that in this specification it is explained that the terms "fine fibrous particles" and "bagacillo" refer to particles of a size sufficiently small to pass through a coarse screen or strainer, one, e.g., having about 225 apertures to the sq. in., each from 0·03 to 0·04 in. in diameter.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922. Tons.
Total Receipts, January 1st to May 30th	1,609,232	..	1,889,832
Deliveries ,, ,, ...	1,594,822		1,800,420
Meltings by Refiners ,, ,, ...	1,433,630	..	1,697,478
Exports of Refined ,, ,, ...	107,000	..	297,000
Importers' Stocks, May 30th	14,410	..	89,412
Total Stocks, May 30th	182,191	..	196,274
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1920 21. Tons.		1921-22 Tons		1922-23 Tons.
Exports	1,091,814	..	1,310,571	..	1,912,392
Stocks	1,071,857	..	997,291	.	756,155
	2,163,671		2,307,862		2,668,547
Local Consumption	42,000	..	50,000	..	40,000
Receipts at Port to March 31st	2,205,671		2,357,862		2,708,547

Havana, April 30th, 1923 J. GUMA.—L. MEJER.

Europe.

Latest Figures of Beet Sowings.

COUNTRY.	1923-24.		1922-23.
Germany	343,520	....	363,789
Czecho-Slovaky	219,486	....	182,849
Austria	12,600	....	11,563
Hungary	41,200	....	29,800
Poland	150,000	....	107,953
Netherlands	70,000	....	57,526
Belgium	65,000	....	59,176
France	150,000	....	116,410
Italy	90,000	....	85,321
Spain	60,000	....	48,045
Denmark	32,000	....	23,944
Sweden	43,700	....	16,716
Yugo-Slavia	29,925	....	24,745
Rumania	39,100	....	22,500
Russia	230,000	....	175,000
Other countries	40,000	....	35,000
Total area	1,616,531	....	1,360,337

THE

INTERNATIONAL SUGAR JOURNAL.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot under take to be responsible for them unless a stamped addressed envelope is enclosed.

No. 295. JULY, 1923. Vol. XXV.

Notes and Comments.

The Market Situation.

There has been a slight fall in the price of sugar in this country during the past few weeks, which has reflected the decreased demand for this commodity not only in this country but also in the United States With us the cold sunless summer that has been a feature of May and June has had its effect on the demand for sugared goods and drinks, while in the States there is no doubt that the recent political agitation against the sugar market has resulted in the public living on their invisible supplies and delaying the purchase of fresh stocks in the hope that the price would break. The entry of Java sugars into the European market of late, whither they have been attracted by the high prices offering, has also had its share in lowering prices.

But there does not appear to be any justification for supposing that this drop in price is the herald of more plentiful supplies. There is nothing to suggest that production has overtaken consumption. The fluctuations have been due to the vagaries of consumption. In the United States, it will only require a steady demand from all over the country for a replenishment of depleted stocks, for the reserves in the hands of the refiners to be largely drawn on and then the price will rise once more. The fruit preserving and canning season is about to commence in that country and this is the season when the greatest demand for sugar ensues. In another month or two we shall have a clearer indication of how the stocks available are going to meet the probable consumption. At the same time, it should be pointed out that opinion in America is not by any means unanimous as to the extent to which the supplies will meet or fall short of the demand before the Autumn beet crops are available. One statistician has it that the Cuban and American supplies will be more than sufficient for the normal requirements of the United States for the rest of the year and any further advance in prices is likely to be but temporary. Others opine that by the end of August or beginning of September there will be a temporary scarcity that will have a marked effect on prices for the time being. In any event there is not going to be any surplusage to speak of, and the outlook for the producer remains entirely favourable for the present and coming crops.

The West Indian Agricultural College, Trinidad.

The first annual Report of the Governing Body of the West Indian Agricultural College at Trinidad (for the year 1922) has just been issued. It is mainly a survey of the steps that have been taken to establish this teaching institution and of the aims of the college authorities. They may be conveniently summarized as follows :—

This college was established as the outcome of the recommendations embodied in the report of a Tropical Agricultural College Committee, appointed in 1919 by Viscount MILNER. Its object is to afford general instruction in tropical agriculture, to give opportunities for thorough training in the science and practice of the subject to those students intending to become tropical planters, investigators or experts in different branches of agricultural science and sugar technology, and, at the same time, to provide facilities for the study of tropical agricultural subjects on the part of graduates from other Universities and Colleges who desire to acquire knowledge of these subjects in tropical surroundings. The Governing Body have had constantly in view the desirability of establishing the College on the broadest Imperial basis so that it may provide for the needs, not only of the British West Indian Colonies and British Guiana, but also of the tropical Colonies of the Empire generally.

While the Governing Body are largely educational authorities domiciled in England, the executive committee who exercise the general control of the college have their headquarters in Trinidad, where also the academic board will naturally reside. The funds of the college have been provided by the colonies of Trinidad and Tobago, Barbados, the Windward Islands and Leeward Islands which have agreed to contribute one-half per cent. of their average revenues of three years preceding 1922, by a grant-in-aid from the Imperial Government (consisting of £15,000 to be spread over five years) and by voluntary contributors, including the British Cotton Growing Association, Messrs, Cadbury Brothers, Ltd., and Messrs. Fry & Sons, Ltd. The Imperial grant is contingent on the college taking over the functions of the Imperial Department of Agriculture and as this has been agreed to, the Department in question has ceased to exist.

Largely owing to the enthusiasm and energy of Sir FRANCIS WATTS and his staff it was possible to throw open the college last October in a provisional building, when 15 students who had passed the necessary examination or were otherwise duly qualified were admitted to residence. Of these, four were post-graduates. Meanwhile the Governing Body has had under consideration the desirability of erecting permanent buildings and research laboratories commensurate with the importance of the college, and also a model sugar factory. In connexion with the last-mentioned, it will be remembered that various British sugar machinery manufacturing firms have generously offered to provide machinery and apparatus to the value of upwards of £20,000. The Report concludes by stating that the wide interest and practical sympathy which the foundation of this college has so generally evoked inspire in the Governing Body confidence as to its future progress and prosperity.

A New College in Mauritius.

There is a great deal to be said in favour of multiplying within limits the number of training centres within the Empire at which the science of agriculture can be efficiently taught, even though the standard of that efficiency may and is almost certain to vary with the particular training institution. We hope and

believe that the new West Indian college will be at the very least a primus inter pares as far as the Empire is concerned. Its curriculum is undoubtedly a great advance on any hitherto existing in British spheres. And, geographically, it has considerable advantages in being within comparative easy reach not only of the Cuban sugar estates where a good deal of practical knowledge can be gleaned, but also of the American training centres whither in many instances a student after completing the Trinidad course may elect to proceed for some further and post-graduate study. For these reasons we doubt not that Trinidad will succeed in proving and maintaining its pre-eminence.

But when that is said, the fact remains that there is not therefore less need for other sugar-producing regions to possess their own training centres. They may be more local in their scope; they may not aim at so high a standard of education as that contemplated at the Trinidad College, but they may within their limits meet a very necessary want, and are of course bound to attract a number of students who are unable to spare the time or afford the expense of graduating at a training centre far removed from their domicile. They may also by stimulating education supply a percentage of men who will take a subsequent course at Trinidad, to the advantage of the latter centre and eventually of the sugar industry concerned.

For these reasons we are glad to learn that Mauritius has decided to have her own academy of agricultural science. It will primarily meet the local needs, but it is bound to add its quota to that class of students who take extended courses in more than one centre with a view to attaining the greatest possible efficiency in the art and science of sugar production—to mention perhaps the principal though not the only subject that the curriculum will contain. Elsewhere we give some details of this praiseworthy effort, in connexion with which preliminary work has been going on for some time past. It has now reached a stage when it is hoped to open the college in temporary buildings in September next.

Some Considerations for the Economic Conference.

Sir Edward Davson recently read a paper before the Royal Society of Arts on the subject of the "Economic Conference and the Colonies" in which he surveyed the possibilities of achievement of the forthcoming Imperial Economic Conference to be held in this country next October, and outlined some of the problems involved. Omitting the Sudan, our colonies proper have—he pointed out—an area of two million square miles, a population of 49 millions, an annual trade of over £550,000,000, and a public debt of only £61,000,000. Their trade with the United Kingdom may be roughly taken as £100,000,000 a year. In respect of these colonies, our object must be two-fold: firstly, to increase their productive power and develop their mineral resources so that their internal wealth may grow; and, secondly, to see that the growth of demand for manufactured goods consequent on this increasing wealth may be filled by this country and by the Empire rather than by foreign countries. One good way to achieve this is, in his opinion, to improve and extend transport facilities. At the same time he thought that the Home Government ought to be prepared to provide or at least guarantee the funds required by the colonies for their development schemes and give them a chance to complete their developments ere they have to meet the charges. "Otherwise one reaches the paradoxical argument that a colony cannot become wealthy until it has developed and that it cannot become developed until it is wealthy enough to pay for it."

Dealing with the question of ensuring a market for the economic crops thus developed, he urged that it was not too much to ask that, wherever duties may be imposed to meet our needs of revenue, a preference should be given to our colonies as against the foreigner, so that whatever be the world's price they may know that we look to them in the first place to supply our wants. In this connexion Sir EDWARD DAVSON made the following remarks on sugar.

"Before the war we drew 80 per cent. of our supplies from Europe and 3 per cent. from Empire sources. When the war came, we were faced with a sugar famine, but fortunately for us the United States, which, like us, had once been dependent on foreign supplies, with a prescience that compels admiration, had steadily, by a system of preferential tariffs, built up a supply for their domestic needs in Cuba and other territories under their control. In the war crisis we turned to these supplies, and we have continued to avail ourselves of them until now in 1923 we are drawing 50 per cent. of our sugar needs from American sources and will this year remit £40,000,000 to America in payment for them. It is true that an attempt has been made to remedy this unsatisfactory state of affairs, and, by the granting of a preference of one-sixth of our duties, we have this year imported 15 per cent. of Empire sugar. But this rate of progress is too slow, or in other words the rate of preference is too low. We know that in the Empire we can grow enough sugar to supply all our needs, and if the preference were increased from one-sixth to one-third and stabilized at the present amount—as recommended by Hon. EDWARD WOOD when Under-Secretary of State for the Colonies in his report on the West Indies—the growing of sugar would receive a great stimulus throughout the Empire."[1]

Finally, SIR EDWARD DAVSON argued that such help as this from the mother country was not altruistic since it was to be presumed that the proceeds of sale in a great measure will be remitted to the Colonies in the form of manufactured goods. "Every bargain must have two sides and on the side of the Mother Country I think it should be stipulated that whenever loans are raised here, all orders for supplies in connexion with the enterprise in view should be placed in this country; and in respect of preferences, these call for reciprocity, and just as a Colony may ask for a preference on its products here, so should the Mother Country expect a preference on its exports to that Colony. I venture to suggest that our aim should be to establish an all-round Imperial Preference and that the rate should be 33⅓ per cent. It is hoped by some that we shall some day see free trade within the Empire, but I fear that this hope is remote, for our dominions have a natural desire to protect their own manufactures and our Colonies are largely dependent on their customs duties for their revenue. I know that there are difficulties in establishing even the one-third remission, and this applies especially to the Dominions. Canada—the pioneer in Empire preference—grants 33⅓ per cent., but Australia for the most part only gives 10 per cent., New Zealand from 10 to 20, and South Africa 3 per cent.; and the matter is not simplified by the introduction of intermediate tariffs. As regards the Colonies, British Guiana and some of the West Indies grant 50 per cent., others 33⅓ and 25, while Fiji gives from 45 to 50 and Cyprus 16⅔. No other colony to my knowledge grants a preference to this country, and East Africa is, I think, hampered in this respect by a foreign treaty which, however, can be denounced by giving six months' notice. I shall not dwell on this subject, but earnestly urge the recognition of

[1] It would certainly prove a stimulus, but we doubt whether any mushroom expansion would result. We think the most that could be expected would be a steady increase that in ten years time would amount to an appreciable percentage of our imports of sugar

the principle of reciprocity and of the establishment of an Empire tariff for an assured period of years, and I would only add that the granting of a preference, if worked out by a scientific readjustment of tariff, does not necessarily mean a loss of revenue to those concerned."

Bank-Assisted Centrals in the Philippines.

It will be remembered that in our issue of March, 1922, we referred to an arrangement working in the Philippines under which six new sugar centrals recently built were financed by the Philippine National Bank till the time when the planters out of the profits from their crops could repay the mortgage and become the proprietors of the centrals. The Bank organized a "Sugar Centrals Agency" to complete the centrals and then gradually transfer the capital holding from the Bank to the planters. It was considered a reasonable investment and had a good prospect of succeeding without loss to the Bank.

Unfortunately the Bank has been in difficulties for some time past and the efforts of its able general manager, Mr. F. W. WILSON, appear to have been futile to restore it to a sound footing. It is not quite clear how the trouble has arisen, but a crisis has recently occurred which has led to Mr. Wilson's resignation. Evidently, he and the Philippine Government have been unable to agree as to the financial operations of the Bank which were intended by bold measures to rehabilitate the agricultural industry of the islands. Anyhow, from correspondence received we learn that the Government has lately been pressing the Bank for money lent it, and the Bank on its part has been forced to approach the planters for re-payment of their mortgage, but these latter are unable to meet their liabilities save by slow degrees. The Bank, we believe, has the right to foreclose on the mortgages and sell the centrals to outsiders, but as the planters are strongly opposed to such a proceeding, it will not facilitate the sale of the properties if these are at the mercy of a lot of discontented cane planters. The latest scheme is to bond the centrals and the Pacific Commercial Company has made an offer, presumably backed by American financiers. How long the Sugar Centrals Agency will continue its activities as a result of this crisis is a matter of speculation. If the bond scheme goes forward this means an expenditure of 20,000 pesos, and the bond holders would very likely bring forward their own experts to take charge of their interests. Meantime Mr. ARTHUR FISHER, formerly the head of the Bureau of Forestry, has been made Chairman of the Sugar Committee of the Bank, and as such is virtually in charge. It is thought that he will authorize the expenditure of another one and a half million pesos for new machinery to extend the milling capacity of the Bank centrals. This machinery should be in by next season, and the orders are expected to be placed locally and at Honolulu.

Whatever the outcome of the bank crisis, which has cost it the services of a very able general manager, it is to be hoped that the Philippine centrals will not suffer any permanent setback or have their utility impaired by lack of funds. In particular, it is to be hoped that the original intention to enable the planters themselves to become the ultimate possessors of their centrals will yet be fulfilled, since thereby is the better ensured a contented industry.

The Validity of Patents.

The president of the Chartered Institute of Patents Agents has drawn attention recently to the procedure more recently adopted by the examiners in the

Patent Office in dealing with British patent applications. In the past the very difficult question whether or not an alleged invention contains good subject matter or, in other words, involves sufficient inventive ingenuity to support a patent, has been left for the Law Courts to determine. The extent of patentable subject matter cannot really be determined till an invention has been put into industrial use and then only before a judicial tribunal capable of hearing and sifting evidence.

But within the last few months it has become apparent that the Patent Office examiners were claiming the right to consider this question of subject matter and in some cases they have rejected patent applications on this ground. They rely on certain decisions which state that an invention in order to form the subject matter of a patent application must relate to "a new manner of manufacture." Hitherto this expression has always been taken in the Patent Office to rule out applications for the protection of financial schemes, systems of book-keeping, and other similar intangible proposals. Now the examiners contend that these decisions impose on them the duty of seeing whether any alleged invention is a good invention. In other words, they are taking on themselves the task which has hitherto been left to a properly constituted Court of Law, and as a consequence there is grave danger of many meritorious inventions being refused patent protection.

In view of this, a number of bodies interested in the working of the Patent Laws, including the leading professional institutions, are being urged to make representations to the Controller of Patents and to the Law Officers of the Crown with a view to preventing this change of practice in the Patent Office from being perpetuated.

The American Beet Sowings.

According to *Facts about Sugar*, the final reports relating to the planting of sugar beets in the United States this summer bring the total acreage for the whole country up to 735,395 acres (as compared with 606,000 acres in 1922). Allowing 8 per cent. for abandoned acreage and taking the average yield of the last ten years, this points to a crop of 6,650,625 short tons of beet to be sliced and a probable production of sugar amounting to 764,518 long tons (856,260 short tons), assuming normal growing and harvesting conditions. If this expectation is realized, the beet sugar crop of the coming season should exceed previous crops with the exceptions of the two years 1920 and 1921.

Conditions reported from practically all beet growing districts indicate that very favourable growing conditions have prevailed during the latter part of May. The prevalence of real summer weather replacing the unseasonably low temperatures that prevailed in most sections during the early part of May has led to the rapid germination of late planted and replanted acreage and lands generally are reported as showing an excellent condition. Should conditions continue to be as favourable as at present a yield somewhat above the average may be expected, and some well informed sugar men are inclined to estimate the crop as high as 775,000 long tons (868,000 short tons) on the basis of existing conditions.

Experiments, said to be highly successful, have been conducted in Louisiana on the production of paper from bagasse. One of the sources of difficulty hitherto encountered has been the separation of the pith, but this was overcome by a process applied by the Dupont Powder Co., who separated this constituent, and used it in their factory at Wilmington, Delaware, for making gun cotton. The treated product was then sent to the Charles Boldt Paper Mill, where a very satisfactory paper is stated to have been made from it.

Fifty Years Ago.

From the "Sugar Cane," July, 1873.

In this issue there appeared the first part of an article on "The Use of Wet Megass as Fuel" by ALFRED FRYER, the Editor of the "Sugar Cane," giving general data for the information of the factory engineer. A table was reproduced showing "the amount of heat generated by 1 lb. of megass, both anhydrous and associated with varying proportions of moisture, the maximum temperature of the products of combustion, and the number of feet of gases and vapour passing up the chimney at 600° F." In regard to the calorific value of bagasse, this was stated to be 6100 B.T.U. per lb. of dry material; and in the case of bagasse containing 50 per cent. of water, the following figures were given: Heat lost by conversion of water into vapour, 1010 B.T.U.; heat lost in the chimney, 1894 B.T.U.; heat available, 3696 B.T.U.; maximum temperature of products of combustion, 1380° F.; and volume of gases and vapours at 600° F. in the chimney, 343 cub. ft.

JAS. T. ARMSTRONG, of Liverpool, gave five analyses of new animal charcoal, and in the course of his accompanying article made the following remarks: "It is an almost universally recognized fact that the decolorizing power of charcoal is improved by being allowed to cool thoroughly previous to use. Many reasons have been assigned for this, but the following is new; and, although at present we are not in a position to prove this, yet from experiments now making on the subject, it seems to be a very likely one, viz., that the charcoal in the process of cooling absorbs nitrogen from the atmosphere. Charcoal becomes useless in proportion as it loses its nitrogen. We find that new charcoal contains about 1·5 per cent. of nitrogen, whilst in old charcoal this amount is reduced to 0·25 per cent. . . . . . ."

SCHEIBLER continued his article on his "New Method for the Direct Determination of the Amount of Refined Sugar in Raw Sugar," and gave a detailed description (with an illustration) of the apparatus which he had devised for the purpose. He also gave a tabulation of results obtained with his method, comparing these with yields calculated in different ways, or actually obtained in practice in the refinery. He had great faith in his process of washing the raw sugar successively with a mixture of concentrated alcohol and ether, somewhat weaker alcohol saturated with sucrose, and alcohol and acetic acid saturated with sucrose, recommending it in the following words: "The best and most brilliant proof of the exactness of my process for the experimental estimation of the value of the raw sugars in refining . . . . . . is that it gives with a single exception the values usually found in practice. . . . . . These results are not dependent, as in the polarimetric assay, on the delicacy of the apparatus, or the sensitiveness of the observer's eye . . . . . . This process besides is so easy of execution that the most ignorant in chemical manipulation is sure to obtain good results. On consideration of these advantages, I have hopes of seeing my process, however little new and original, judged as offering the complete solution of the question presented for competition . . . . . ." However, later workers found that his methods involved serious sources of error, such as the precipitation of sucrose from the wash-liquors on the crystals of sugar undergoing the washing treatment, and the impossibility of calculating the amount and the composition of the molasses. It will be remembered that later KOYDL[1] modified the procedure, so as to give approximately quantitative results.

[1] *I.S.J.*, 1909, 204.

The Sugar Duties.

Debate in Parliament.

The 1923 Finance Bill was last month considered in Committee of the House of Commons, and when the sugar duties came up for discussion, Mr. A. V. ALEXANDER, who represents co-operative society circles, moved the total repeal of these. His arguments were in effect that the tax was iniquitous in its effect on the working class consumers, both as regards sugar and sugar-containing foods like jam. He commented on the great increase in sugar taxation since the war; in 1913 the yield of the sugar duties was £3,000,000 per annum, whereas nowadays it amounted to nearly £40,000,000 and was an *ad valorem* tax of about 80 per cent. at present-day prices. He objected to the preference on home-grown sugar, alleging that it had made a present of not less than £115,000 to Kelham factory, a good deal of which, he averred, went into the pockets of Dutch capitalists. He also questioned whether the granting of a preference to the British West Indies was of any benefit; he certainly thought our taxpayers had lost though it.

Mr. ASQUITH, while not going so far as to suggest that the total repeal of the duties was desirable or feasible since then the £38,000,000 derived from them would have to be found elsewhere, nevertheless pressed for a reduction in the rate; he declined to believe that our consumption of one and a half million tons per annum could have any marked effect on a world's price covering some 18 million tons, if that consumption were increased somewhat by a reduction in the duties. That being so, he was satisfied that there was no form of relief from direct taxation which would produce such large and beneficial results both to industry and to consumers in this country as a reduction in the sugar duties.

Sir WILLIAM JOYNSON-HICKS, Financial Secretary to the Treasury, who replied for the Government, reminded Mr. ASQUITH that it was the latter's Government that during the war had put on 1½d. of the present 2¾d. duty per lb. on sugar "I want the Committee to realize that, in spite of the very high taxation upon sugar at the present time, the consumption of sugar in this country is again going up. The agitation for the reduction in the Sugar Duty is carried on on the ground that the people of this country cannot get the sugar which is necessary and beneficial to them, but that is not quite correct. In 1912 the consumption of sugar per head was 79 lbs. throughout the country. It reached its highest point in 1913, when it was 83 lbs., and in 1920 it fell, after the high taxation had been imposed, to 51 lbs. per head. It is now gradually going up, in spite of the taxation. In 1921 it was 64 lbs., and last year it was 74·6 lbs. Really, therefore, from the point of view of the health of the people, which, I think, was referred to by the hon. Member who moved the total repeal of the duty, it is quite clear that the consumption of sugar in this country to-day is approaching its highest pre-war point, which it reached in 1913."

He then went on to explain that the Government had relied very largely on the statements published early in the year by the Sugar Department of the U.S.A. Government forecasting a considerable shortage of sugar at this year's carry-over. [He afterwards accepted the correction of Mr. RAMSEY MACDONALD that Mr. HOOVER had subsequently revised those figures and admitted the shortage was less than the Sugar Department led the American press to suppose.] He next gave figures showing how continuously and steadily the price of sugar had risen. "In January, 1922, it was 10s. 6d. per cwt., and it rose practically every month last year, until in December it was 17s. 9d. per cwt. In January of this year it was 17s. 6d., in February 18s. 6d., in March 27s., and in April 27s. On

27th April it was 33s. 6d., and on 25th May 31s. 9d. I am very glad to say that to-day it is a little less, namely, 29s., but it will be seen that there has been an enormous and steady rise during the last 18 months in the price of Cuban sugar."

Again he quoted passages from the *Economist* which had confirmed the view taken by the Chancellor of the Exchequer that if there had been a change of duty favourable to the consumer, there would have been a jump in the demand and this would have afforded another weapon to the American speculator. So for the present the Government preferred to leave the duty as it was. "I am sure," he concluded, "Hon. Members on this side agree with me in hoping the position of the world market will be such that we may have a reduction at an early date, but we are not going to give that reduction so long as it would merely play into the hands of the American speculator."

Lieut.-Colonel COURTHOPE defended the granting of a preference to the home beet factories; he controverted the statement that the losses incurred on these factories had come out of the pockets of the taxpayers; on the contrary the loss was written off by a reduction of the shareholder's capital to 5s. in the pound. He told the House that wherever the beet sugar industry had been successfully started it had been fostered by the Government during the development period, owing to its extraordinary intricacy. It was intricate and novel in several respects. The sugar beet required a method of cultivation which was quite novel to the British farmer and labourer. Cantley, started in 1912, only had its first full and profitable season last year. He thought however that the development period for each successive factory would tend to be shorter because knowledge and information would be disseminated and those who had learnt in one factory could go and take charge in another.

The amendment to repeal the duties was finally defeated by 257 votes to 153, a majority of 104.

Dr. C. S. HUDSON, the well-known authority on the structure of carbohydrates, has joined the sugar staff of the Bureau of Standards, Washington, U.S A.

H.M. Minister at Stockholm reports that the Swedish sugar import monopoly has been withdrawn from 1st June by a Royal Decree, dated 11th May. Sugar may now be imported into Sweden without restriction, and the price of sugar is no longer subject to State control.

About two years ago the firm of PETREE & DORR Engineers, Inc., was organized to introduce to the cane sugar industry of the United States, Cuba, Hawaii, the Philippines, Porto Rico, Santo Domingo, Haiti, Mexico, and Brazil the Dorr Clarifier and the Petree Process, the combination of which is recognized as the most revolutionary improvement in raw sugar production that has occurred for many years. During this development period of two years, the Company has conveniently been managed by the Dorr Company at their New York offices. But the very rapid growth of the business has latterly made it imperative to form an entirely separate and autonomous organization. Accordingly since the middle of May the firm of PETREE & DORR ENGINEERS, Inc., has been located at separate offices at Munson Building, 67, Wall Street, New York, and at Banco de Canada, Havana, Cuba. Mr. P. M. HUGH is to be the new President and General Manager of PETREE & DORR, while Mr. C. G. PETREE and Mr. J. V. N. DORR are Vice-Presidents. In addition, Mr. C. G. PETREE will be Consulting Engineer to the Company. The territory of the Company will be greatly enlarged to include in addition to the above-mentioned countries, the Dutch East Indies, British India, Japan, Formosa, Mozambique, Egypt, Angola, Argentina, and Central and South America generally. All enquiries emanating from these countries should henceforward be addressed to the Company, at New York. A competent staff of sugar engineers and chemists is being rapidly built up to meet the needs of the extended territory.

On Insect Transmission of Mosaic, especially in Java.[1]

A useful paper on this subject by G. WILBRINK[2] has recently come to hand, and gives a good deal of information on the history of cane mosaic, besides a detailed description of the author's own experiments and observations. The following notes have been extracted as likely to be of general interest. The disease has always been known in Java, where it was first observed, as yellow stripe, and this term is used throughout the paper, while *Aphis maidis*, rendered famous in sugar cane countries because of E. W. BRANDES' work on transmission, is spoken of as *Aphis adusta*, and we retain the author's terminology.

Yellow stripe of the sugar cane is undoubtedly one of the mosaic diseases, a term due to ADOLPH MAYER in his description of tobacco mosaic in 1882. The most striking common characteristic of these diseases is the occurrence of light green or yellow stripes or spots on the green parts of the plant and especially the leaves. But in other organs the coloration of affected plants is often of a different character, strongly coloured parts have lighter and lightly or uncoloured parts have darker markings. Thus the canes in Black Cheribon have yellow or light red marks, while the light coloured DI 52 has dark red striping, the white flowers of tobacco have flame red, and the orange or red flowers of Canna have lighter spots.

As a rule, full grown organs are little susceptible to these changes, the first appearances being noted in young parts; diminished vigour of growth is almost universal and sometimes abnormalities are met with, but death is rare except in localized areas, small dead spots being observed in the young shoots of some varieties of sugar cane when grown from diseased sets. KAMERLING in 1902 observed these in Black Cheribon, and later LYON in H 27, H 207 and H 296, where they were seen on mature leaves as well. In severe attacks similar local deaths occur on the stems, the epidermal cells and those below turning brown with the formation of splits. Such were noted by the author in Black Cheribon, White Preanger, Loethers, 247 B and Lahaina. These splits closely resemble the corky markings characteristic of healthy canes in such varieties as the Tannas, and WILBRINK proposes to describe the differences between them in a future paper on the anatomy of canes affected by yellow stripe. She draws especial attention to the disease described by WENT as the "Djombangsche Stengelstrepenziekte[3]," which appears to be a case in point, although WENT dissociates this disease from the yellow stripe. The stem markings, occurring as they do mostly when diseased sets are planted, are apparently much rarer in Java than elsewhere, because of the great care exercised for many years in selecting sound seed for fighting yellow stripe. Splitting and even cankering of the stem has been freely observed in Porto Rico, and this has at times raised a doubt as to whether the yellow stripe of Java is the same disease as mosaic in the New World. LYON speaks of brown spots in the pith of diseased Lahaina plants, but these have not been observed in Java. For the rest, secondary death or "necrosis" occurs in other mosaics than that of the sugar cane, but is not usually considered as symptomatic of the disease.

Mosaic disease is met with in many wild and cultivated plants, as the following list of families will show:—Solanaceae, Cucurbitaceae, Phytolaccaceae Oeno-

[1] A former general article on Mosaic disease is given in *I.S.J.*, 1921, pp. 12-19.

[2] Een onderzoek naar de verbreiding der gelenstrepenziekte door bladluizen (A study of the spread of Mosaic by plant lice). G. WILBRINK. *Mededeelingen van het proefstation van der Javasuikerindustrie*, 1922, No. 10.

[3] A good account is given of this disease in Die ziekten van het suikerriet op Java. WAKKER en WENT, 1898. Details of its microscopic appearance are shown on Plate XII.

theraceae, Passifloraceae, Papilionaceae, Chenopodiaceae, Malvaceae, Commelinaceae, Cannaceae, Musaceae, Liliaceae, Gramiuaceae; and each year new forms are added, for only recently have the wild plants been specially examined as possible sources of infection. As at present known the disease is carried by vegetative reproduction, the only case of its transmission by seed being in the bean. It has on the other hand always been regarded as infectious, since MAYER demonstrated this in the tobacco mosaic, but only very recently has definite proof been obtainable in other cases. Grafting has been successful especially in Malvaceae and in potatoes, and this has succeeded in transferring the disease where all other methods have failed. KAMERLING thought it to be infectious in the sugar cane, but it is considered that his test plants had not been carefully isolated, and the disease also appeared in his control plots. No success was obtained by LYON, WILBRINK or STEVENSON in transmitting the sugar cane mosaic, and only in 1920 did BRANDES ultimately succeed. He transferred the sap of diseased to healthy canes in free air and under mineral oil so as to exclude the chance of oxidation; and this latter method proved remarkably successful, in that 8 out of 10 experiments gave results, whereas of 65 experiments in air only 3 succeeded. Apparently the virulence of the sap is quickly lost in the sugar cane. But, although the infectious nature of mosaic has been definitely established for certain plants, no one can say what the disease really is. No certain organism has been isolated, though bacteria and amoeba-like bodies have been credited by various observers as causing the disease. But certain definite characters of the causal agent, whatever it is, have been determined. Thus it is capable of resisting temperatures up to 60°C., whereas 50°C. will destroy all non-spore-forming organisms. It has great filtering powers, passing through unglazed porcelain and agar agar, and resists such chemicals as ether, chloroform and alcohol.

As no organism has been definitely detected, a number of theories have been propounded as to the origin of the disease. BEYERINCK suggested a "contagium vivum fluidum" and WOODS an enzyme, this latter idea having induced the writers of most text-books to include mosaic among the enzymatic diseases. HUNGER suggested a poison, brought into play by unfavourable conditions; LODEWIJKS and VAN DER STOK ascribed it to bud variation; while some speak of a spontaneous origin, and VAN HARREVELD noted a sudden infection up to 100 per cent. in a set of seedlings with Chunnee blood in them.

Outside Java the first record of sugar cane mosaic was in Egypt, where KOBUS saw it in 1909 in seedlings of Java origin. It was, it is true, observed in Hawaii in 1908, but it was not till 1910 that, independently, LYON and VAN DER STOK diagnosed it as the yellow stripe. When first noted in Hawaii it was found to occur over wide areas, with intervening free tracts. In 1911 it did not exist in Kauai, but was imported there in 1912 when Lahaina, being planted next to diseased plants which had been introduced, fell a victim to it. The first record in the New World was by STEVENSON in Porto Rico in 1917, it having been observed in 1916, and within three or four years three-quarters of the cane fields in that island were infected. Being found on young canes recently imported from Louisiana, a search was at once made for it in the United States, and it was found to be widely distributed over the sugar cane States in the south. Curiously enough in all cases it was found near to sets recently distributed from the Experiment Station at Audubon Park, but later observations showed its presence in a part where no canes had been received from that place since 1914.

With these facts before them, it is not to be wondered at that a firm belief in the infectious nature of cane mosaic established itself in the minds of sugar cane

workers in Hawaii and America, and intensive studies were carried out, especially in the United States, to determine the exact means by which it was propagated from plant to plant. It was known in 1906 that curly leaf in the beet only occurred in the presence of a cicada *Eutettix tenella* Baker, but nothing precise was known concerning the connexion between this insect and the disease. TAUBENHAUS, in 1914, showed that the mosaic in Lathyrus was in all probability carried by a plant louse; DOOLITTLE and JAGGER, in 1916, followed with the cucumber; in 1917, ALLARD demonstrated in cultures that *Myzus persicae* could transmit it in tobacco and also showed that this probably occurred in nature through *Macrosiphon tabaci*; in 1918, MCCLINTOCK and SMITH reported a similar occurrence in spinach; SCHULZ, in 1919, showed it in potato mosaic, while in 1920 OORTWIJN added leaf roll in the same plant.

Meantime, a gradual change was taking place as to the nature of the disease and its cause. The former spontaneous appearance was regarded as possibly due to insect transmission, and with regard to the special case noted by VAN HARREVELD, it was noted that mosaic is sometimes very difficult to detect in Chunnee-Cheribon seedlings, so that possibly the sets planted were themselves diseased. There were fewer adherents to the poison, enzyme, and bud variation theories. BRANDES, in Washington, started an investigation in sugar cane mosaic in a culture house, and soon was rewarded by observing that Sorghum and certain grasses became infected by the disease when covered by *Aphis adusta* (*Aphis maidis*); and, acting on this hint, he demonstrated that this insect was able to transfer the disease from Sorghum to sugar cane and maize. This discovery of BRANDES in the United States caused the author again[1] to take up the study of yellow stripe in Java in 1920, this time in connexion with *Aphis adusta*, which had been originally described by ZEHNTNER on the sugar cane there.

This work proved extraordinarily difficult, for nowhere could the insect be found on the sugar cane. One case was met with where adusta was present on two dying leaf sheaths of a late shoot in shade, but it was found impossible to transfer the insects to other cane plants, and both they and the shoots on which they were found died. During the whole of 1921 the search continued, but it was not until January, 1922, that further examples were seen, and the means discovered by which their presence could be with any certainty detected. It appears that they attack the sugar cane inside young leaf sheaths, and their action is so injurious that the latter turn sickly and, unless they quickly move away, usually die; their attack is often accompanied by an invasion of small ants, and the observation of these on sickly sheaths assists considerably in their detection. When the leaf sheath dies, the insects also die or disappear. The insects were found, in the second instance, on plants of EK 2 and DI 52 which had been introduced between rows of maize, which completely overshadowed them. Later, cane plants put out among grass and maize were attacked by the aphis, and the sheaths showed the characteristic yellowing and dying. Working from this basis the food plants of *Aphis adusta* were carefully studied, and among them many common weeds of the cane fields were found. The following is the list of food plants recorded in the literature, besides sugar cane mentioned only by ZEHNTNER:—*Zea Mais*, Sorghum, *Setaria italica*, *Pennisetum typhoideum*, *Triticum sativum*, *Avena sativa*, *Cynodon Dactylon*, *Panicum Crus-galli*, *Panicum colonum*, *Paspalum sanguinale*, *Polytrias amaura*, and *Eleusine indica*. WILBRINK added *Saccharum spontaneum*, *Dactyloctenium aegyptiacum*, and *Pennisetum*

[1] A former paper by the author, in conjunction with F. LEDEBOUR, is published in the *Archief van der suikerindustrie in Nederlandsch Indie*, 1910, p. 465.

macrostachyum. In Cheribon and Tegal, where the work was done, the food plants grown near sugar cane were *Zea Mais*, Sorghum, and less commonly *Setaria italica*, all of which were much affected by *Aphis adusta*: many of the weeds mentioned are common near and in the cane fields, and *Cynodon Dactylon*, *Paspalum sanguinale*, and *Panicum colonum*, all three favoured food plants of the Aphis, occur everywhere in the cane tract; none of the weeds mentioned in the list are very rare. It is a curious fact that, while so many of its food plants are among the canes, *Aphis adusta* only visits the cane, as it were, by chance, and its poisonous effect is seen after a very temporary stay. After weeding the fields it quickly disappears from the cane leaf sheaths.

The next point to be investigated was whether yellow stripe was present in any of these host plants of adusta, and this search was at first unsuccessful. Better results were obtained by introducing diseased sugar cane plants among them. In June, 1921, Sorghum was thus infected, though very poorly, but very much greater success was attained during the wet, west monsoon of 1921-2, and then many plants were attacked. Weather conditions were, in fact, shown to be an important factor in the spread of the disease and, indeed, this had many times been observed before in the cane fields. The markings on the Sorghum leaves were very similar to those on the sugar cane, but they often disappeared later, again returning in young shoots after flowering. Although growth was less vigorous, no great damage appeared to have been done by the disease, and all efforts to reproduce the disease by sowing the seed of infected plants were fruitless. Similar sucess was obtained among weeds during the west monsoon of 1921-2, *Panicum colonum* and *Paspalum sanguinale* being readily infected. The markings on the leaves of these grasses were again similar to those on the sugar cane, but were less distinct and quickly disappeared, while no evil effects were observed. Here, also, seed sown from infected plants produced only healthy plants. In January, 1922, maize also was infected on similar treatment; the markings were, however, different from those on sugar cane, being much smaller and of a lighter yellow, so that affected plants could be detected at a distance. Although many recovered, the markings on most plants remained to the end of the life of the plant. No coloration was observed in the stem, nor in the pith as recorded by KUNKEL, and no great difference was observed between healthy and diseased plants. On sowing the seeds of diseased plants no cases were seen in the seedlings.

During these observations *Aphis sacchari* everywhere obtruded itself. It was abundant on the sugar cane leaves and especially on older ones beginning to fade, and was very abundant also on Sorghum: it was indeed present in such enormous quantities on the latter plant that it was a wonder that they were able to exist. The normal colour was yellow, but a rose-red variety was found on *Panicum colonum*, which seemed to have a very injurious effect on that grass, as it often died from the attacks of the Aphis. This red form was never observed on the sugar cane. In spite of long continued and heavy attacks, the sugar cane did not appear to suffer from this aphis, possibly because of its chief occurrence on leaves which had done their work. It did not appear to have any association with yellow stripe.

The main results of WILBRINK's field observations were, thus, that the only considerable migration of *Aphis adusta* to the sugar cane occurred when it was growing near the favoured food plants of the insect, and that yellow stripe was only observed in the latter when diseased sugar cane was grown among them. The probability was thus strongly suggested that yellow stripe is infectious and may be transferred through the agency of adusta. Having gained this amount of information during observations covering two years, a definite series of care-

fully controlled experiments was instituted. And as *Aphis sacchari* was so very common on the sugar cane it was included in the experiments.

Five main experiments are described in detail, with the following results. In four experiments with *Aphis sacchari*, one showed transmission of yellow stripe, but this case was ruled out because it became evident that proper isolation had not been attended to. In the two experiments including *Aphis adusta*, wide transmission was observed, while none was seen in the controls; the infection cases were indeed so numerous that this insect appears to be a very active agent in the spread of the disease. BRANDES' observations were thus not only confirmed, but extended: he showed transmission from Sorghum to sugar cane and to maize, whereas WILBRINK added it from cane to cane and from cane to grasses. Since the completion of this piece of work, KUNKEL, working with the same two insects, obtained no results with *Aphis sacchari*, but observed transmission with *Aphis adusta* from maize to sugar cane. BRANDES also reported that BRUNER in Cuba, testing a number of insects, obtained the transfer of mosaic only with *Aphis adusta*, and CHARDON in Porto Rico, whose results were not yet published, obtained even more convincing confirmation of the United States results.

The question of control is still difficult. Hitherto it has been determined by the knowledge that the disease is passed on by diseased sets, and has consisted mainly of the selection of sound seed for sowing and roguing the young fields. The definite knowledge of transmission by one insect in practically all parts of the world, through the help of many weeds common in the cane fields besides cultivated plants commonly grown in sugar cane countries, opens up new lines of control to which attention will now be directed.

The weather also has been proved to be of marked influence, as it affects both the multiplication of the transmitting insect and the growth of the grass flora in the fields. Damp cloudy weather favours both of these, and so much so that it becomes difficult to exercise efficient control by keeping the young cane fields clean, even in the best kept fields, especially where water channels exist. Adusta has only been found to attack young shoots, and it has been often noted that the spread of the disease is far more commonly met with in young fields. In those fields where the overlapping of the cane leaves prevents the rapid spread and growth of weeds, infection is severely checked, and this is now seen also to be due to the distaste of the insects for attacking older leaf sheaths and leaves. The danger is less in those places where cane planting takes place during the dry weather, for the obvious reason that weeds cannot make great headway and that adusta shuns dry sunny places. In Java the *tegallans*, or fields where the cane is not grown in rotation with rice, are especially liable to yellow stripe: the absence of the cleaning action of the rice crop makes it very difficult to keep such fields free of weeds, and so on. In fact, many of the difficulties and contradictions hitherto met with in yellow stripe investigations are now smoothed out and explained, and this must have its effect, in the near future, in greatly assisting the control of this puzzling disease. Constant clean weeding is obviously demanded, and this affords yet another proof that pests and diseases in the cane fields can, broadly speaking, be best controlled by more careful agricultural operations, a point on which we have insisted constantly in recent years.

One further matter discussed by the author may be referred to here. It has, namely, been frequently questioned whether the comparative rarity of *Aphis adusta* in the cane fields and especially on the cane plant, which it does not apparently care for, provides sufficient means for the spread of the disease. WILBRINK has found it hidden in the sheaths of young cane shoots much more frequently in Java than had been suspected. But these visits are usually short, since the

sheaths appear to be quickly poisoned, and the insect does not remain, as does *Aphis sacchari* on the dying leaves. According to KUNKEL, the period of incubation is at least 12 days, so that actually the appearance of yellow stripe may be first noted when no adusta is present, and this is no doubt frequently the case. WILBRINK has observed many so-called "flying visits" of the insect to the cane leaves, and of course most of such visits are likely to escape observation: she has observed cases where such casual flights have resulted in the disease developing. The extremely poisonous nature of the puncture by *Aphis adusta*, while lengthened feeding by *Aphis sacchari* appears to be without effect, is not the least surprising feature of the case. Similarly, it will be remembered, the rose coloured form of *Aphis sacchari* soon kills *Panicum colonum*, its favourite food, and these singular facts seem to call for still more intensive study of the natural history of the cane fields. The value of WILBRINK's paper is increased by a copious and well selected literature of mosaic, prominent among which are the Dutch publications on the subject.

C. A. B.

An Agricultural College for Mauritius.

Close on the heels of the foundation of the West Indian Agricultural College in Trinidad, comes the news that the preliminary work which has for some time been going on in Mauritius, has been completed with the result that a similar College will, it is hoped, be opened in temporary buildings in September of this year. In some respects the new College has the advantage over that in the West Indies. In the first place it is in the hands of a single Government, and all the difficult initial discussions as to location and proportional provision of funds by different legislatures have been avoided; and doubtless its flotation has also been rendered much easier through the unexampled prosperity of the sugar industry in Mauritius during the last few years. In the second, although the training of students for sugar cane work has for many years been going on in certain of the West Indian islands (notably, for instance, in Antigua), there would appear to be in Mauritius a much more connected development which has preceded the starting of the new College. "Its foundation is the result of gradual evolution from small beginnings, it took its origin in the training of students at the Station Agronomique which was enlarged and extended to form the School of Agriculture at the time of the formation of the Department of Agriculture in 1913. The Agricultural College is the result of the further development of the latter undertaking." On the other hand as regards the recruitment of the necessary staff, Mauritius has not had the advantage of the well developed technical organization which SIR FRANCIS WATTS has perfected in the Imperial Agricultural Department of the West Indies. In Mauritius there is also the difficulty of a dual language, English and French being necessary for all well educated residents in the Colony. It is interesting, moreover, to note that, in a way, both of these Colleges owe no small debt of gratitude to the little school of sugar instruction opened over thirty years ago by SIR FRANCIS WATTS when island chemist in Antigua, and which was continued and developed by his successor, Dr. TEMPANY, who is chiefly responsible for working out the details of the Mauritius College.

The Prospectus of the new College, which has recently reached us is, perhaps it is needless to say, a business-like production, and the training, while primarily aiming at the development of the sugar industry, which is the main staple of the Colony, extends over a very wide range. The College "will, when complete, include laboratories for the study of chemistry, botany, zoology, entomology and

sugar technology, with lecture rooms, library, and workshops. Attached to the College will be the experimental fields, nurseries and stock farm of the Department of Agriculture. It is projected that, at a later date, facilities will be provided for practical studies in relation to sugar manufacture."

Students will, as usual, be required to pass an entrance examination, in order to ensure their being able to take advantage of the instruction provided. This examination comprises English and French grammar and composition, elementary mathematics, general knowledge and, we are glad to see, geography. The course of instruction is apparently continuous, and candidates may receive a certificate at the end of two years or a diploma at the end of three. Both of these will have special reference to careers in the sugar industry of the island. During the first two years, the number of subjects in the curriculum is, at first sight, sufficiently alarming, but it must be remembered that the instruction will of necessity be extremely elementary, as no previous knowledge is required of any of the sciences dealt with: this will require considerable care on the part of the teaching staff. In the first year the subjects include chemistry, physics, botany, zoology and agriculture, book-keeping, surveying and manual training (in agriculture?); and, in addition, a general survey of tropical agriculture will be made. Agricultural science, which has now a sufficiently well known meaning, might perhaps have taken the place of the first five of the list, when it would have been shorn of some of its terrors. The teaching in the second year deals with the technical application of these sciences, besides including building construction, animal husbandry and veterinary science and agricultural engineering. An interesting and important minor feature is the inclusion in both years of the making of collections in the field. In the first year a collection must be made of 24 properly named common weeds and poisonous grasses and 15 common grasses; in the second, 12 specimens showing fungous and bacterial diseases and 20 insect pests of the various cultivated plants in the country.

The third year is to be devoted chiefly to sugar work—agricultural chemistry including the chemistry of carbohydrates, sugar-house control, sugar husbandry, agricultural economics and agricultural law. Special arrangements will be made for those students, possessing an adequate knowledge of elementary chemistry and physics, who desire to qualify as sugar-house chemists, by transferring certain subjects from the second to the first year and others from the third to the second, thus enabling them to complete their course in two years. Those who pass will be entitled to a certificate in agricultural chemistry and sugar technology.

The College has the great advantage of being more or less limited to Mauritius conditions, and is primarily designed for British subjects. Thus, the fee for those born in the island and its dependencies is Rs. 150 per annum, Rs. 300 for students from other British Colonies, and Rs. 450 for foreigners. Each year two scholarships, carrying free tuition, will be allotted, but only to local students. For these the entrance examination will be extended to include three of the following:—Latin, chemistry, physics, botany, advanced mathematics, and English and French history. Prizes and medals are arranged for each year's work, and a "Laureateship" or travelling studentship for two years will be available each year for students who have completed their course in the College. The candidates will be required to follow certain prescribed courses of instruction, and may also be called upon ultimately to take up positions on the College staff as lecturers or assistant-lecturers at salaries previously agreed upon.

The Advisory Board (Governing Body) has been elected and is printed in the prospectus; it consists of the Principal as ex-officio Chairman (Dr. TEMPANY),

four members of the Board of Agriculture nominated by the Governor, two by the Chamber of Agriculture and two by the Société des Chimistes. The staff is in the main already recruited and the names are given of those in charge of the chief subjects with here and there additional lecturers still to be appointed. Lecturers have still to be found for agricultural engineering, surveying, building construction, accounting and agricultural law.

C. A. B.

Death of Mr. F. I. Scard.

We much regret to have to record the death after a prolonged period of ill health of Mr. FREDERIC I. SCARD, F.I.C., the well known sugar chemist and expert, which took place at a nursing home in London. He was 69 years old and for some 43 years had been associated with the sugar industry, mostly in the employ of the Colonial Company (first in Demerara whither he went in 1881 and more recently in London), and after that in consulting practice and journalistic work in London. In the course of that long period he acquired an unrivalled knowledge of the sugar industry and its conditions, especially that connected with the West Indies, and was looked on as an authority in this subject.

Born in London in 1853, SCARD was educated privately and at the Royal College of Chemistry. He first became assistant to Dr. PAVY, F.R.S., from 1874 to 1881; after that he went out to British Guiana and began his long association with the Colonial Company in Demerara, being indeed the first chemist to be attached to a sugar estate in that colony or for a matter of fact the British West Indies. He stayed 23 years in Demerara and then for seven years further was associated with his firm in London. When the New Colonial Company was wound up, SCARD remained in London in consulting practice and was a regular contributor to the *West India Committee Circular* and (less frequently) to the *International Sugar Journal*. There was no doubt as to the excellence of his judgment not only in sugar matters in which he specialized, but also in the affairs of every-day life as to which his views were remarkably sound. Although a warm friend of the West Indies, he was not blind to the tendency of those colonies to lag behind in scientific progress, and he never hesitated to criticise their policy of laissez faire when he thought it was detrimental to their ultimate good.

SCARD was responsible, we understand, for adapting phosphoric acid to the manufacture of Demerara sugar, and for the use of sulphate of ammonia for fermenting purposes in the distilleries in British Guiana. His contributions to literature have consisted both of publications, and of papers to the technical or other press. As to the former, he compiled "The Cane Sugar Factory," an elementary manual for beginners in sugar manufacture; and he was co-author with Mr. LLEWELLYN JONES in publishing that excellent elementary work, "Manufacture of Cane Sugar," which not long since came out in a second (revised) edition. Of his contributions to the press, reference may be made to those appearing during the past six years in this journal (apart from frequent papers on economic subjects):—

"A Few Thoughts on the Milling of the Cane"; 1916, 450.
"The Scientific Control of a Rum Distillery"; 1916, 298.
"Molasses as an Indication of Inversion"; 1919, 604.
"West Indies and Industrial Alcohol"; 1921, 46.
"Power Alcohol in the United Kingdom"; 1921, 434.
"Are Cane Pests Inevitable?"; 1922, 208.
"Demerara Sugar, its Definition"; 1922, 318.

Mill Trials of Selected Coimbatore Sugar Cane Seedlings.[1]

By WYNNE SAYER, B.A., Secretary, Pusa Sugar Bureau.

It has been generally recognized that the problem of the improvement of the Indian sugar industry is primarily one of increasing the tonnage of sugar cane per acre, the establishment of new factories on modern lines and the improvement in their efficiency ranking next in importance to it. While Java produces over 40 tons, Hawaii 41[2] tons and Cuba 20 tons cane per acre, over the greater part of Northern India, where by far the largest portion of the total area under cane in India is grown, the average yield is hardly 300 maunds or 11 tons per acre. It will thus be seen that, while a factory in Java working with 500 tons of cane per day can be supplied with its raw material for one day's working from 12 acres, a similar factory working in Northern India has to draw on no less than 45 acres entailing increased expenditure on cartage and laborious arrangements for the supply of cane, and this results in keeping down the number of factories which can work profitably in a given cane area. The question that awaits immediate solution is thus primarily one of improvement in the yield of cane per acre so that the cultivator may derive increased profits and the factories may be enabled to get their raw material from a smaller area.

Now, it is well-known that the cultivator in Northern India has usually not enough money to spend on manures and that his cultivation is indifferent. What is required, therefore, is a better yielding variety which can stand this indifferent treatment and at the same time give a higher tonnage per acre without much manure. In this connexion it has been found that of the three recognized lines of improving the tonnage per acre by the (1) introduction of exotic varieties, (2) selection and improvement of indigenous canes and (3) raising new cross-bred canes, the one depending upon the importation of foreign canes is not likely to lead to permanent and substantial results. These exotic varieties, produced for totally different conditions and found successful there, are unsuited over large tracts in Northern India, where the cultivators are not in a position to give them the required careful cultivation, heavy manuring and irrigation. Further, these canes are liable to disease, and hence it is that in spite of repeated importations only a very few have made good as field crops and these too in tracts which are specially suited for thick canes, *e.g.*, Madras, Bombay, Bengal and Assam. The second line, viz., the selection of indigenous varieties and their cultivation according to improved methods, does not hold out any prospects of substantial results for the simple reason that the increased yields are not always commensurate with the extra expenditure involved, the extra tonnage failing to produce a proportionate amount of sugar owing to the limitations of the varieties themselves.

As in all other countries, the line of work that holds out the greatest prospects of success is that of raising seedlings by crossing the exotic varieties with the best local canes. The sugar cane breeding Station at Coimbatore has, therefore, concentrated its attention on evolving new seedlings on these lines. This station, though mainly intended for North Indian work, had to be located in South India because cane rarely flowers in North India, and even when it does, does not generally set fertile seed. It will thus be seen that the canes bred at Coimbatore require to be acclimatized and tested in North India before they can be distributed

[1] From *Agr. Journ. India*, xviii, 249-256.

[2] The yield of cane per acre for the whole of the Hawaiian Islands during the years 1921 and 1922 was 41 tons (1 ton = 2000 lb.), though in Maui and Oahu the average was as high as 50 and 48 tons respectively.

to cultivators. In this connexion it is necessary to emphasise that a reliable and careful testing of the new seedling canes in the tracts for which they are ultimately intended is as important as the actual raising of these seedlings by the complicated and laborious process of cross-pollination.

It was early recognized that exotic canes are not worth persevering with under the conditions existing in the white sugar tract in North Bihar. Attention was therefore concentrated at Pusa on the acclimatization and testing of Coimbatore seedlings. Work in this direction has now been in progress for over five years.

It was found after the first two years that three seedlings, viz., Co 210, Co 213 and Co 214, were likely to prove suitable for Northern India and accordingly in January, 1921, arrangements were made to multiply up these canes according to the Java method to provide sufficient seed to plant out a large area for mill trials in December, 1922. This method of short planting for rapid multiplication of seed of a particular variety had hitherto not been attempted in this country, but in the present writer's opinion there was nothing in the local conditions to prevent it from succeeding and it was accordingly tried and proved an immediate success. This method enabled the three seedling canes to be put through the mill by the end of 1922, a saving of over three years as against the ordinary method.

The method adopted was as follows :—The cane was planted in February and forced on under irrigation until the break of the monsoon in July when the entire cane was cut and replanted in high land. By the following February this cane was ready to cut for seed again and one acre originally planted in February gave sufficient seed to plant 36 acres in the following year.

The chemical analysis had already shown that Co 214 was an exceptionally early ripening cane and that it was followed by Co 210 and Co 213 which ripened in succession, thus forming an extremely valuable chain of early ripening canes all maturing before the end of December. The value of this can be understood when it is realized that hitherto it had been practically impossible for any factory in Bihar to start crushing before the second week in December, as the local cane being a late ripener was not fit to work before that date at the earliest. It was clear, therefore, that if these canes proved a success at the mill, they would lengthen the working season of the factories considerably and enable the latter to increase their output of sugar. The field tests showed that all these canes were an improvement on the local cane on a tonnage basis, the improvement being most marked in the case of Co 210 and Co 213, the latter being an exceptionally hardy, vigorous and heavy tonnage cane. With a view to test these canes thoroughly under factory conditions, an area of 22 acres was planted out in February, 1922, in the proportion of 10·99 acres under Co 214, 6·01 acres under Co 213 and 5 acres under Co 210. The land chosen was part of an area recently taken over from ryots and was not considered by local growers to be good land for cane nor in any way exceptional, and it was felt that under such conditions a thoroughly fair trial under estate conditions of the tonnage capacities of these three canes might be expected. Arrangements were made to have the cane taken by the mill at the earliest possible date—beginning with Co 214 and followed by Co 210 and Co 213 in the order named so as to ascertain their behaviour under mill conditions and the sugar actually yielded by them as compared with the best local variety.

It is necessary here to emphasize that such mill trials are essential for ascertaining the actual value of a cane to the factory. As the analysis made in a laboratory where the juice is expressed by a 2 or 3-roller mill gives much higher results than those obtainable in a factory where many other factors have

to be taken into consideration, to base all calculations on the laboratory results alone does not meet the case. The value of a cane is its value to the grower and to the mill when grown and crushed in bulk, and figures obtained from large scale tests are the figures which really carry weight among the growers and the mills. The laboratory and experimental plot tests are excellent guides but do not represent final judgment in such cases.

A brief description of the *method of cane growing* followed at Pusa would not be without some interest to the reader. The land to be put down under cane in February was kept fallow from the previous October and given a thorough preliminary cultivation. Early in February the furrows were opened out with a double mould board plough, followed by a subsoiler working in the furrow to stir up and loosen the subsoil. Oil-cake at the rate of half a ton per acre was then applied and the sets placed in the furrow, end to end, and covered in with a gatherer. The distance between the rows was kept at 3 ft. The only after-cultivation given was one hoeing every month in the hot weather and ridging up at the break of the rains. It is necessary here to mention that sugar cane is grown throughout the white sugar area in North Bihar without irrigation and has to stand several months of intense heat before the monsoon breaks. These Coimbatore seedlings were also grown without irrigation. These canes are reputed to be good drought-resisters and their behaviour during the growing season was excellent. The hot weather of 1922 was a most trying one and a temperature of 110° F. was experienced on several days with hot winds. During this hot weather Co 213 never showed any drying of leaves. Co 214 and Co 210 also stood it remarkably well. After the rains these canes made rapid progress and early in July their superiority over the local canes began to assert itself. While there was a slight shoot-borer attack in Co 214 and Co 210, the variety Co 213 was free from any fungus or insect pest. These cane have a hard outer rind and so are not damaged by jackals. The average yield of stripped cane per acre amounted to 600 maunds of Co 214, 700 maunds of Co 210, and 800 maunds of Co 213. The cost of cultivation including preparatory tillage, rent, manuring, price of sets, planting and after-cultivation averaged Rs. 125 per acre. The crop was seen by the majority of the large sugar cane growers of Bihar, and their opinion of it is best shown in the fact that applications for seed would have required twenty times the available area to meet them.

It has been mentioned above that one of the objects in growing these canes on a large scale was to ascertain their value from a factory point of view. Accordingly, arrangements were made with Messrs. BEGG SUTHERLAND & Co. to conduct the mill tests at one of their factories situated at Ryam, near Darbhanga. The writer desires to take this opportunity of expressing his obligations to this firm for the great assistance they have given him not only in connexion with these mill tests but also in financing sugar cane experiments on a large scale. Without their financial assistance this work could not have been carried out, and their ready appreciation of the value of the work is the best testimony to its general importance to the industry as a whole.

The first mill trial took place on the 6th December, 1922, when 2444 maunds of Co 214 were supplied to the factory for crushing. This cane is ripe by the beginning of November when the local cane Hemja is still unfit for the mill. An early cane is a great desideratum with the factories in North India and as Co 214 will enable them to extend their working season, the value of this cane is to be judged mainly from that point of view. Its yield is certainly double that of the best local cane Hemja, but as one of the parents of this cross-bred cane is Saretha,

it has inherited a recumbent habit and is liable to be blown down by high winds. Another undesirable character in this cane is its high fibre content (18 per cent.) which is the result of having *S. spontaneum* as one of the parents. In spite of these two defects Co 214 is a good cane not only for the cultivator but also for the factory as the following results of the mill trial will show :—

COMPARATIVE ANALYSIS OF THE FIRST MILL JUICE.

	Co 214 crushed on 6th Dec.		Hemja (local variety) crushed on 7th Dec.
Brix	19·30	....	16·70
Sucrose....	15·94	....	13·54
Purity	82·58	....	81·08

It must, however, be remembered that Co 214 was being crushed at a much later date than originally intended and a comparison between it and Hemja taken in the second week of November would have given even more satisfactory results.

The second mill trial took place on the 18th December when over 2000 maunds of Co 210 were put through the mill. This cane has a better tonnage than Co 214 and its fibre content is lower (15·66 per cent.), but it is a month later in ripening. The following are the results of analysis of the first mill juice; Brix, 18·23; sucrose, 14·95 ; purity, 82·00.

The last mill trial took place with Co 213 on 27th December, 1922, when 2500 maunds cane were supplied to the Ryam factory. Of the three canes this is clearly the best cane from the grower's point of view. It is a straight cane, does not lodge easily, has an even growth, is practically immune from fungus and insect pests and yields on an average 800 maunds of stripped cane per acre. Its fibre content is 16·84 per cent., i.e., lower than that of Co 214. The results of the factory analysis of the first mill juice were: Brix, 17·63; sucrose, 14·52 ; purity, 82·86.

It is clear that the Co 214, *apart from the increased tonnage which it gives compared with the local cane*, actually yielded about 15 per cent. more sugar in the factory and as this variety can be crushed at a time when no local cane is worth milling, the sugar extracted from it is all *clear gain* over that which could be extracted from any local variety at the time. With Co 214 a factory can begin its campaign early in November, in December it can carry on with Co 210 and Co 213. Thereafter the local cane Hemja which usually ripens in January becomes available for crushing and thus the factories will be able to work under optimum conditions. As soon as the results of the mill trials became known, there arose a very heavy demand for these canes. From the cane left over from the present crop a distribution was, therefore, made to important cane growers in all the districts of North Bihar to avoid the loss of a year, and full instructions were supplied to enable these growers to multiply the seed cane by the short planting method. Arrangements have also been made for a further distribution of these canes from some 60 acres in February, 1924, to the members of the Cane Growers' Association in Bihar who have provided the necessary finance for the purpose.

These varieties have also been supplied in small quantities to the Cossipore Sugar Factory, and are reported to be making good progress. Co 213 has been despatched for trial as far east as Dacca and as far west as Peshawar.

If the results so far obtained at Pusa are realized on the cultivators' fields as it is believed they will, having regard to the fact that these are hardy canes which can stand even indifferent cultivation, a distinct step forward will have been taken in improving the material condition of sugar cane growers in North India, in increasing the output of sugar factories located in this tract and in finding room for the establishment of more factories, while subsequent years should find us in a position to deal with tracts requiring a special cane to meet special conditions.

As it is generally recognized that these seedling canes deteriorate after some time, the replacement of the varieties already given out is engaging attention, and at the date of writing the author has got another early cane planted under estate conditions for a mill trial and no fewer than 40 new seedlings are being grown for testing and multiplication.

The author desires to express his thanks to the Imperial Agriculturist and his staff for the continued assistance and facilities afforded to him, also to the Imperial Agricultural Chemist and his staff for the analysis of various sugar cane samples sent to them from time to time, and finally to Dr. BARBER and Rao Saheb T. S. VENKATRAMAN, the Government Sugar Cane Experts at Coimbatore, whose original work was the foundation of all that is now being done by the Sugar Bureau.

The Effect of superheating Unlimed Cane Juices.

By R. G. W. FARNELL,
Chemist, British Empire Sugar Association.

During my recent visit to British Guiana I had the opportunity of seeing at work a system of clarification which involves superheating raw cane juice before liming and settling.

During 1921 trouble was experienced in making a raw 96° sugar suitable for refining. In fact, certain refineries, both in England and Scotland, complained about the poor quality of the Demerara sugars which, when dissolved in water, gave "muddy" solutions filtering very slowly.

An analysis of the molasses produced in refining Demerara raws compared with Cuba raws, revealed the following:—

Refinery Molasses.	Silica (SiO_2)[1] on Dry Matter. Per cent.	"Gums" (Organic Matter Precipitated by Alcohol).[2] Per cent.
Demerara..	0·60	1·35
Cuba	0·40	0·62

Attention was drawn to a recent article by C. MULLER,[3] in which he describes the advantages of superheating raw juices, and also the rôle played by colloidal silica, in causing unsatisfactory defecation. He concludes that silica may be present in the juice in organic combination as a "complex" body of a colloid nature, though it may be present also in mineral combination. "While juices extracted by crushing in mills may neither defecate nor filter through paper, yet the juice from cane obtained by diffusion may defecate very easily, giving a liquid of perfect limpidity passing rapidly through paper or cloth."

If Muller's assumption is correct, and that "complex organo-siliceous bodies of a colloid nature" do exist in juices (especially from immature cane), then it is reasonable to suppose that juice obtained by crushing in mills will contain these colloidal bodies, which, not passing through the unruptured cell membrane, will be absent from diffusion juices.

Furthermore, MULLER states that lime will not precipitate the colloidal organo-silica, but only the mineral silica. He recommends superheating the raw juice to 116°C. (241°F.) which coagulates the organo-siliceous bodies, and renders the silica capable of being precipitated by lime along with the mineral silicates of the juice.

[1] Calculated on the dry matter of the molasses.
[2] Presumably calculated on the actual molasses. [3] I.S.J., 1921, 579.

He quotes the following figures to illustrate the point:—

	Juice defecated by usual method, limed, sulphited, and heated to 102°C.		Juice superheated to 116°C., limed, sulphited at 80°C. and heated to 100°C.
Silica precipitated, grms. per litre of juice..	0·30	....	1·40

In addition to the effect of superheating on the destruction of the organo-siliceous bodies, MULLER also claims a complete precipitation of the gums which are not eliminated in ordinary defecation. "Under these conditions the lime added to the juice after superheating may be diminished to about one-third of the usual quantity without inconvenience, leading also to an economy of sulphur."

Since the silica and gums in the refinery molasses from Demerara raw sugars were both in excess, comparing unfavourably with those from the Cuba sugars, Muller's claims were put to the test, first in the laboratory, and finally in the factory.

The initial results obtained were described by Mr. MAURICE BIRD.[1] Since then certain modifications have been made, and further factory figures are available.

THEORETICAL.

Inversion of sucrose.—The most important point to be considered in examining a process which involves superheating raw juice is the risk of inversion. The whole question of the inversion of sucrose is by no means yet settled, though undoubtedly general ideas have been considerably cleared since recognizing the effect of the hydrogen ion, and the principle of the hydrogen ion determination as being the only trustworthy basis of referring acidities.

Amongst other factors the following will determine the inversion of sucrose on heating raw cane juices:—(1) Acidity of juice (hydrogen ion concentration); (2) temperature to which the juice is heated; and (3) time at which the juice is maintained at that temperature.

With regard to (1) as far as I am aware the acidities of the juice in this superheat system have not been measured on the basis of hydrogen ion concentration.

NOËL DEERR[2] described laboratory experiments he made on the effect of heating clarified juices (tempered to definite acidities) in an autoclave kept at 115°C. (239°F.) for 30 mins. The acid used was oxalic acid, which is much more strongly ionized than the acids naturally occurring in the cane, e.g., malic, aspartic, and glycolic acids. The hydrogen ion concentration of his artificial juices was probably in the neighbourhood of pH 4·0, for an acidity of 1 c.c. normal per 100 c.c. juice, referred to phenolphthalein. Even at these high acidities no detectable inversion occurred, and he concluded that "it was impossible to say precisely where destruction of sugar began when juices were exposed to an elevated temperature (115°C.) for a period such as 30 mins. The results obtained, however, indicated that any loss under factory conditions would be very small."

Two points are apparent here: (*a*) The hydrogen ion concentration of the juice used in Deerr's experiments was greater than the average H ion concentration of raw juices, which BREWSTER and RAINES[3] find to be round pH 5·0 for Louisiana juices; and (*b*) the time of heating, 30 mins., bore no relation to the conditions obtaining in Muller's system, merely involving the passage of the juice through high velocity juice heaters, i.e., a period of from 2 to 3 mins.

[1] *I.S.J.*, 1923, 44.

[2] *I S.J.*, 1916, 561. [3] *I.S.J.*, 1923, 88. [4] *I.S.J.*, 1920, 643, 699.

ZERBAN,[4] in studying the kieselguhr and "Norit" system of clarification, boiled raw juice at natural acidities without detecting any appreciable loss of sucrose by inversion; while CROSS[5] carried juice sulphured to 3·0 c.c. final acidity without any increase in the glucose ratio. In this case, however, the effect of the calcium sulphite in depressing the ionization of the sulphurous acid must be taken into account, and therefore comparisons with raw juices are not justified, since here the calcium sulphite effect is absent.

One might suppose those juices which are high in mineral content (i.e., those having an ash equal to 0·7 to 0·8 per cent.) to be less liable to undergo inversion on superheating than juices with low ash. NOËL DEERR,[6] in an exhaustive series of laboratory experiments, concluded that juices might suffer half-an-hour's heating at 120°C. (248°F.) without detectable loss of sugar, though temperatures safe for one juice might be detrimental for another of different composition, especially regarding the mineral content.

Precipitation of colloids.—For our present information on the nature of the colloids of cane juice we are indebted to NOËL DEERR,[1] who found that the colloids were coagulated by heat and alkali. "(1) Colloids once coagulated by rise of temperature (to not less than 88°C. or 190°F.) do not pass into the colloid state on cooling, and hence the condition is irreversible as regards temperature. (2) The colloids when coagulated by the addition of alkali resume the colloid condition on neutralization of the alkali, and hence the colloid state is reversible with reference to alkalinity and acidity."

Superheating the juice before liming therefore should cause coagulation. This, of course, is well known in the case of certain proteins, but the effect on the other colloids present, such as the gums and possibly pectic substances, is not so clear.

It was found by the author during a preliminary investigation of the pectins[2] that heating "pectinogen" solutions to the boiling point (i.e., 100°C.) caused no precipitation provided calcium salts (e.g., calcium chloride) were absent. In weak acid solutions (i.e., acetic acid), however, the colloid was coagulated by calcium chloride on boiling. No experiments were made on the effect of superheating. At the present stage of our knowledge of pectic substances it is not possible to define the optimum conditions of temperature and acidity (referred to hydrogen ion concentration) to ensure their precipitation and removal in the factory.

From information received from South America it appears that no precipitation of gums during superheating occurs below 108°C. (226°F.).

EXPERIMENTAL.

As previously mentioned, before putting Muller's system to the factory test, laboratory experiments were conducted to determine the effect of superheating raw juice with regard both to possible inversion and destruction of any organo-siliceous compounds which might be present.

The juices experimented on were principally derived from D 625 cane grown on soils of marked alkalinity, the subsoil water averaging about 0·8 per cent. dissolved mineral water.

An autoclave was extemporized out of a piece of iron pipe, closed at one end, and threaded at the other, so as to take a brass cap bored to allow a thermometer to pass through.

The raw juice after analysis was placed in the autoclave and heated up to the desired temperature. It was then allowed to cool to below 100°C. before unscrewing the cap and removing the juice for the second analysis. In all cases there

[5] *I.S.J.*, 1914, 312. [6] *I.S.J.*, 1911, 105. [1] *I.S.J.*, 1916, 503-504. [2] *I.S.J.*, 1923, 248.

was a marked diminution in the silica content of the superheated juice, and also in the amount of lime (or clear lime water) necessary for neutralization and satisfactory defecation.

Some results illustrating this are given below :—

Experiment.	Nature of Juice.	Silica per cent. of Dry Matter.	Silica precipitated per cent Silica in Juice.	Lime necessary for Neutralization, c c.	Remarks.
	Raw juice	0·148	—	0·35	Clear lime-water used for neutralization.
A.	Juice heated to 218°F. (103°C.)	0·060	59·5	0·10	Clear lime-water.
	Juice heated to 241°F. (116°C.)	0·036	75·7	0·11	Clear lime-water.
	Raw juice	0·195	—	3·40	Lime cream of 10° Bé. used for neutralization.
B.	Juice heated to 248°F. (120°C.)	0·082	57·9	1·25	Lime cream of 10° Bé. used for neutralization.
	Raw juice	0·117	—	19·0	Clear lime - water for neutralization.
C.	Juice heated to 218°F. (103°C.)	0·053	54·7	9·8	

The glucose ratio figures fluctuated considerably, showing both increases and decreases from the raw juice figures. It must be remembered that these laboratory experiments were performed under difficulties in the ordinary sugar laboratory attached to the factory. The apparatus was somewhat crude, and the error in the analysis probably considerable, except in the case of the silica estimations.

No gum determinations were carried out, but as regards the precipitation of silica and decrease in lime necessary for defecation, these laboratory experiments bear out Muller's claims.

The Process in the Factory.

When first tried at factory A, the raw juice was heated to 220°–240°F. (104·5°–115·5°C.) in two horizontal high-velocity Harvey juice heaters, from whence it flowed into an explosion box before straining through inclined sheets of 100-mesh gauze. The juice was then limed to phenolphthalein neutrality, reheated to 212°F., and settled.

A considerable quantity of material was separated at the strainers, averaging 0·4 per cent. of the weight of the juice. A partial analysis of two samples of this substance was made :—

Experiment.	Temperature of Superheating.	Deposit (dried), per cent of the Juice.	Ash, per cent. of the Deposit.	SiO_2, per cent. of the Ash.
I.	241°F. (116°C.)	0·44	58·74	34·03
II.	220°F. (104·5°C.	0·32	54·37	36·91

It appears that the substance strained off after superheating consisted both of fine *bagacillo* which had passed through the mechanical strainer at the mill, and silica precipitated by the superheating. Ordinary *bagacillo* ("cush-cush"), when grinding D 625 cane only, contains about 6 per cent. to 10 per cent. ash, depending, of course, on the soil conditions, rainfall, and extent of manuring; whereas the deposit at the strainers contained 54–58 per cent. ash. Part of this mineral matter, however, may have been derived from the soil adhering to the canes, which were not washed before entering the mill.

When the superheat process was tried at factory B, there were no facilities for straining the juice after superheating. Contrary to expectation, however, no

difference was found in the clarification, which was as satisfactory as at factory A. It would seem that the matter precipitated by the superheating, together with the *bugacillo*, is beneficial in causing the mud to settle in the clarifiers.

After eight weeks' working the 100-mesh strainer was removed. The juice superheated to 240°F. (115·5°C.), was limed and settled without additional heating. Under these conditions the limed juice entered the clarifiers at 208°F. (98°C.). After settling, the juice was markedly free from suspended matter, which made itself apparent in the superior quality of the sugar made.

The following figures have been recorded for two successive grinding periods, the second of which includes the superheat system:—

	Recovery of Sugar from Juice.	Purity of Clarified Juice.	Purity of Final Molasses.	*Bagacillo*, per cent. Sugar.	Polarization of Sugar.
Period to June 3rd, 1922.—Old system of clarification; juice limed, heated, and settled.. ..	87·67	78·4	34·7	0·137	95·7
Period to December 11th, 1922.—Juice superheated, and strained, then re-heated and settled	89·00	79·4	33·6	0·108	95·84
Last five weeks of grinding.—Juice superheated, limed, and settled..	91·25	80·2	33·1	0·057	95·94

The effect of superheating is apparent in the lower purity of final molasses giving a higher recovery, and in the decreased amount of suspended matter in the sugar made.

At present no information has been afforded as to the molasses analyses. The figures for silica and "gums" (alcoholic precipitate) would be of special interest, inasmuch as any effect which the superheating might have in precipitating the colloids would be revealed on comparing the molasses produced with and without superheating.

CONCLUSIONS.

At present one can only conclude that superheating raw unlimed juice for from 1 to 2 mins. to temperatures varying from 218°F. (103·5°C.) to 250°F. 121°C.) precipitates part of the silica present, which has been assumed by MULLER to be in organic combination and in the colloidal state. It is likely also that decomposition of some of the "gums" (alcoholic precipitate) occurs, the amount of lime necessary for satisfactory defecation thus being reduced.

It is feasible to argue that the juice from cane D 625, grown on alkaline soil with waters rich in mineral content, would be especially suitable for superheat treatment. This has been found in certain factories where the recovery of available sugar has increased, and a superior quality of raw sugar manufactured since working the process. However, optimum conditions as to the temperature of superheating, and the advantage of straining off the precipitated matter, have not yet been settled to complete satisfaction.

Further investigations are needed to find out: (1) The connexion between the hydrogen ion concentration of the raw juice and the inversion of sucrose during superheating; (2) the effect of superheating juices of different hydrogen ion concentration on the decomposition of those substances which are precipitated by alcohol (usually referred to as "gums and pectins"); (3) a more precise knowledge of the nature of the silica contained in juices from cane of different maturity, environment, etc., and especially to distinguish between the colloidal and crystalloidal modifications of that substance.

It is hoped shortly to begin working on the above lines at the West Indian Agricultural College as soon as the necessary apparatus is available.

Theory of the Cause and Propagation of Explosions of Sugar Dust.[1]

By GEORG JAECKEL.

INTRODUCTION.

Dr. BEYERSDORFER has recently treated[2] the question of the explosion of sugar dust in such a detailed and many-sided manner that scarcely any new point of view for the origin of such phenomena can be suggested. In addition to the thermal explanation, which till then had been the only one advanced, he proved experimentally in this research that "cold sugar dust" could be ignited electrically, opening up in this way a new line of investigation of the problem.

This present research, which was commenced at a time when I still believed heat to be the only possible method of ignition in practice, and when so-called "electrical explosions" were regarded purely as laboratory experiments, confirms in all points Beyersdorfer's work. It brings together a series of theoretical considerations, which in many directions amplify his views.

THERMAL DUST EXPLOSIONS.

Hypotheses of thermal ignition.—If sugar dust be heated slowly it melts, decomposes, and evolves gaseous constituents, leaving behind a residue of carbon, burning only with difficulty at temperatures over 600°C. On the contrary, if sugar dust be thrown on a metal plate heated to more than 410°C., it deflagrates like gunpowder, and is completely consumed. Obviously the decomposition is altogether different, being subject on whether the dust is brought slowly or quickly to a high temperature. The dangerous nature of sugar dust depends on the fact (among others as well) that on account of its fineness it can be brought to a higher temperature more quickly than large sugar crystals. A further circumstance, making the smaller particles of dust more dangerous than the greater, is the film of condensed gases adsorbed on the surfaces,[3] which relatively are large in proportion to their mass, these gases promoting the combustion.

If now a cloud of sugar dust comes into contact with a heated metal plate, an explosion will occur if two conditions are met: (*1*) the temperature of the plate must be higher than the ignition point of the dust; and (*2*) the concentration of the dust must lie within certain limits. BEYERSDORFER[4] by a careful estimation has found the lower one to be 17·5 kg. per cub. metre, and experimentally has determined the higher to be 13·5 kg. per cub. metre. On account of the great importance of the safety limit for the propagation of an explosion, some simple theoretical considerations will be exposed, by which the lower and the upper limits can be calculated from the known thermal constants of sugar.

Lower limit of concentration.—If a flat piece of metal, heated to a temperature over 410°C., be brought into a cloud of sugar dust, at first only the portions of the cloud adjacent to it will be inflamed, and the explosion of the whole will be effected only when the ignition is propagated quickly from one unit to the next adjoining it. Obviously the condition controlling the explosion is that the amount of heat produced in one unit of space must be sufficiently great to heat an adjacent one to the temperature of ignition. The burning sugar dust present in 1 cub. m. of space must raise the air and dust of an adjoining cub. m. to the temperature of explosion which, according to BEYERSDORFER, may be accepted as 410°C.

[1] *Vereinszeitschrift*, 1923, 117–135. This is an abstract, not a literal translation, of the original article.
[2] *I.S.J.*, 1922, 578. [3] *Kolloid Zeitschrift*, 1922, 31, 331–332. [4] *I.S.J.*, 1922, 574.

If c_1 the specific heat of air at constant volume $= 0 \cdot 17$ calories per grm. per degree centigrade; s_1 the density of air at 10° C. $= 0 \cdot 00125$ grms. per cub. metre; q, the heat of combustion of sugar $= 4000$ calories per grm.; c_2, the specific heat of sugar = about 0·35 calories per grm. per degree Centigrade; t, the initial temperature = 10° C.; T, the ignition temperature = 410° C.; p, the amount of dust present in the cloud in grms. per cub. metre; n, amount of sugar dust in grms. per cub. metre which can be completely combusted by the air present; and V, the loss of heat in calories per cub. metre, caused mainly by radiation into parts which are not directly adjacent, then the condition mathematically expressed for bringing about the explosion is :—

$$p \times q \geqq V + (T - t)\ (p \times c_2 + c_1 \times c_1) \qquad (1)$$

$$p\ [q - (T - t) \times c_2] \geqq V + (T - t) \times s_1 \times c_1 \qquad (2)$$

V, the loss of heat by radiation and conduction to parts of the cloud not directly adjacent to the source of heat, will depend on the nature of the walls of the explosion chamber, that is, whether they be heated previously to a high temperature, as in Beyersdorfer's experiments, in which case the burning sugar dust does not require to heat the outer spaces, and V thus becomes negative. Assuming a case in which $V = O$ for the calculation of the most favourable condition for the propagation of an explosion, so as to obtain an absolutely certain limit of explosion, then the right hand side of equation (2) has under normal conditions the value :—

$$(T - t)\ s_1 \times c_1 = (410 - 10) \times 0 \cdot 00125 \times 0 \cdot 17 = 0 \cdot 085 \qquad (3)$$

But the left hand side of the equation contains an uncertain value, namely the specific heat of sugar in the neighbourhood of 10–410° C., no value having been established for the decomposition gases formed (hydrogen, carbon monoxide, and methane); but here one can assume an average value, viz., 0·35, as the reliability of this figure is not of great influence on the result, the heat of combustion (q = 4000 calories) being great in comparison with the value :—

$$(T - t) \times c_2 = 400 \times 0 \cdot 35 = 140 \text{ calories per grm.} \qquad (4)$$

After substitution of the values (3) and (4) in the equation (2) the lower limit of explosion is expressed by the following :—

$$p\ (4000 - 140) \geqq 0 \cdot 085 \text{ cal./cub. metre}$$

$$p \geqq \frac{0 \cdot 085}{3680}$$

$$p \geqq 22 \text{ grms. per cub. metre}$$

This value differs little from Beyersdorfer's of 17·5 grms. per cub. metre, though this investigator had in view the determination of an absolutely certain limit of safety.

Upper limit of concentration.—In a very similar way, the upper limit of explosion can be theoretically established. The oxygen in 1 cub. metre of a dust cloud can oxidize only a definite amount of sugar (n grms.), the rest remaining unconsumed, and if more than n grms. of sugar be present per cub. metre, it means that only a certain part is completely combusted to CO_2 and H_2O, and that the remainder is converted to carbon monoxide, aldehydes, ketones, acids, and the like. Theoretically the simplest and most favourable case is that only n grms. of sugar are completely burnt, the rest being decomposed only by heat (without the action of oxygen), no heat of oxidation being evolved. Finally, therefore, a concentration P must be reached, above which an explosion is impossible. This may be calculated by the equation :—

$$n \times q \geqq V + (T - t)\ (c_2 \times P + s_1 \times c_1) \qquad (6)$$

Here, however, together with the usual loss of heat, there is the heat of melting, decomposition, and gasification of the sugar, so that a fairly certain upper explosive limit should be represented by the equation:—

$$c_2 \times P \leqq \frac{n \times q - V}{T - t} - s_1 \times c_1 \qquad (7)$$

Taking 0·000255 grm. per cub. metre as n, (as the result of a calculation of the oxygen required for the combustion of sugar, and the weight of the oxygen in 1 cub. metre of air), and assuming again the most favourable condition of $V = O$, we obtain:—

$$\begin{aligned} P &\leqq \frac{n \times q - V}{(T - t)\,c_2} - \frac{s_1 \times c_1}{c_2} \\ &\leqq (0{\cdot}00728 - 0{\cdot}00061) \text{ grms. per cub. metre.} \qquad (9) \\ &\leqq 0{\cdot}007 \text{ grm. per cub. metre.} \\ &\leqq 7 \text{ kg. per cub. metre.} \end{aligned}$$

However, the upper limit of explosion thus found can hardly have the same degree of accuracy as the lower limit p calculated in the manner shown above, since the uncertainty in regard to the value of the specific heat and the heat of decomposition of the sugar at 130–410° C. has here a very disturbing effect. Experimental determinations must, therefore, be made to corroborate the theoretical value. At any rate the agreement with Beyersdorfer's limit of 13·5 kg. per cub. metre is not unsatisfactory, considering that this investigator had used in his determinations a particularly small vessel, the walls of which were externally heated. Loss of heat by radiation and conduction to the outer spaces of the cloud did, therefore, not occur; in fact on the other hand, there was a considerable addition of heat, so that V become negative. Further, seeing that in his experiments the air was pre-heated to the temperature of ignition, the factor $s_1 \times c_1$ disappears in all equations, so that after all he should have obtained a higher value.

Ignition by sparks.—So far in the calculation of the lower and upper limits we have always dealt with the most favourable case for the production of an explosion, namely, that the ignition is effected by a flat source of heat, a plate, or the side of a disintegrating machine, for example. Fig. 1, representing a section of a heated partition, shows that the flow of heat from such a surface proceeds in one direction only in bringing about the ignition of the room filled with dust; while it can further be seen that a unit of dust space has to ignite an adjacent one only, as is so in the case of Equation (1).

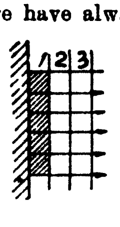

FIG 1

FIG 2

Altogether more difficult is the propagation of an explosion in which only single particles of dust are ignited by sparks, since then heat has to be evolved on all sides. If a spark flies through a cloud of dust, and ignites all the particles of dust lying along its path, each of these particles of dust must in turn ignite its neighbours if the explosion of the whole cloud is to occur. Fig. 2, which represents a section of the path of a spark through a cloud of dust, shows that the central space (shaded) on ignition must in turn ignite eight adjoining ones. If the heat of a spark is sufficient to ignite only a single particle of dust, then the chance of the propagation of the explosion becomes yet more unfavourable, for the volume which has become ignited must give its heat to 26 adjoining volumes. Since the temperature of a glowing particle of metal causing a spark is not much higher than the ignition point of sugar, since further the specific heat of the metal

is one-third that of sugar, and since again the size of the spark is very minute, it will be realized that the ignition of particles of sugar dust by means of a spark flying through them is very difficult. Before it can take place, the particles of sugar dust must be melted, decomposed, and also gasified, and all these operations demand much heat.

But taking the most favourable case, let us assume that it is really possible to ignite a row of particles lying along a path of sparks, so that every volume which is ignited must also ignite eight adjoining volumes of the same size. Now, how great must be the smallest concentration of dust to make the propagation of an explosion possible, and also how great must be the highest concentration?

In this case, instead of Equation (2), we have for the lower limit:—

$$P \geqq \frac{8\,(T'-t)\,s_1 \times c_1 + V}{q - 8\,(T'-t)\,c_2} \tag{10}$$

and, instead of Equation (7), for the upper one we have:—

$$P \leqq \frac{n \times q}{8\,(T-t)\,c_2} - \frac{s_1 \times c_1}{c_2} - \frac{V}{8\,(T-t)\,c_2} \tag{11}$$

Substituting the values obtained from Equations (3), (4), and (8), we have:—

$$p \geqq \frac{8 \times 0{\cdot}085 \text{ cal. cm.}^{-3} + V \text{ cal. cm.}^{-3}}{4000 \text{ cal. grm.}^{-1} - 8 \times 140 \text{ cal. grm.}^{-3}} \tag{12}$$

$$\geqq \frac{(0{\cdot}680 + V) \text{ cal. cm.}^{-3}}{2880 \text{ cal. grm.}^{-1}}$$

$$\geqq [0{\cdot}000236 + 0{\cdot}000347 \times V] \text{ grm. cm.}^{-3}$$

and in regard to the upper limit, we have:—

$$P \leqq [(0{\cdot}00728 \times 8) - 0{\cdot}00061] \text{ grm. cm.}^{-1} - \frac{V \text{ cal. cm.}^{-3}}{8 \times 140 \text{ cal. grm.}^{-1}} \tag{13}$$

$$\leqq [0{\cdot}000300 - 0{\cdot}000893 \times V] \text{ grm. cm.}^{-1}$$

It is thus seen that, even for the ideal case in which no loss by radiation or conduction occurs, the lower and the upper limits almost coincide, since on eliminating the value V in the Equations (12) and (13) the range lies between the very narrow limits of 236 and 300 grms. per cub. metre.

Therefore, it follows that ignition by sparking is only possible in a cloud of dust of this concentration. But in practice there always occurs a loss of heat owing to radiation and conduction to remote volumes of the dust cloud; then again the heat consumed in melting, decomposing, and gasifying the eight adjoining particles must narrow this range yet further. Consequently it would seem that the ignition of a cloud of dust by sparks may be regarded as impossible in practice.

Electrical Dust Explosions.

Electrical charging of dust.—Although it was formerly generally accepted that the explosions occurring in practice were brought about by the ignition of the dust by heat, Beyersdorfer's experiments[1] have shown that ignition by electrical means is possible. He first demonstrated the strong electrical charging of a cloud of dust; then he brought about an explosion by means of the silent discharge in an ozonizer the inner surface of which was coated with sugar dust; and finally he showed that by blowing sugar through a narrow slit by means of air under a pressure of 100 atmospheres the same luminous appearance occurred as was observed in the alternating field of the ozonizer. That in this case, however, no

[1] *Loc. cit.*

explosion actually took place was due to the fact that the particles of sugar dust that remained only a very short time (about 1/1000th of a second) in the vicinity of the electrical charge; and furthermore to the fact that the cooling of the air following its expansion was so great that the cloud of dust could not be ignited, even with an open flame.

Beyersdorfer's experiments have therefore provided the proof that an explosion of sugar dust can be brought about (without heat) through a foreign source of electrical energy. Since a cloud of sugar dust can become strongly charged by friction or whirling,[1] one can count on the possibility of ignition spontaneously by electrical ignition.

It thus appears of interest to establish (once more by calculation) how strong the charging of a cloud of sugar dust must be in order to make its spontaneous ignition possible.

[Following this, the author gives formulæ expressing the energy in an electrically charged cloud of dust; the "electric-static pressure" of the cloud of dust; the energy necessary for the ignition of the cloud of dust; the electric charge necessary for the spontaneous ignition of a cloud of dust; and the charge in electro-static units per grm. of dust necessary for the ignition of clouds of various concentrations. In the case of a cloud of sugar dust having the form of a cone of radius R, and having a concentration of p grms. per cub. metre, the electrical energy in electro-static units K per grm. of dust sufficing for the ignition is:—

$$K = \frac{10^3}{p \times R} \sqrt{1{\cdot}42 + 2340\,p}$$

and a table is given showing K for concentrations from 1 grm. to 7 kg. of dust per cub. metre, R being equal to 100 cm. In this way the value found for K for a concentration of 255 grms. per cub. metre was $5{\cdot}6 \times 10^4$ units.]

Propagation of dust explosions.—It is easy to understate how the electrical charging of dust particles (as a new source of energy) may favour the propagation of dust explosions. A layer of dust which has been warmed is aided in reaching the temperature of its ignition by its inherent electrical energy. In this way, by the presence of electrical charges, the lower limit for the propagation of the dust explosion is reduced, and the danger of ignition is reduced.

But in another respect the charging of the dust particles promotes the propagation of an explosion, as was demonstrated by one of Volta's experiments. If two isolated plates having opposite charges be separated, then work is performed in opposition to the electrical power of attraction, the capacity of the condenser is diminished, and its electrical energy and its voltage are increased. In a corresponding way, by bringing together two similarly charged plates, or by compressing a cloud of similarly charged particles, an increase in the voltage with an accumulation of electrical energy is obtained. In an explosion it is therefore possible that the pressure wave brought about in another portion of the room in which charged particles are floating, by the sudden compression of these particles generates such an electrical energy that ignition takes place there also. In this way, in the presence of electrically charged particles of dust, the propagation of dust explosions from one space to another may take place without the penetration of a flame being necessary.

[1] *I.S.J.*, 1922, 575.

Hydrogen-Ion Determination in Refinery Control.[1]

By H. Z. E. PERKINS.

While the condition of the material worked in a sugar refinery may be tested at many points and its variation may be observed at all stages, actually the control of the acidity and alkalinity is exercised as a rule at a few points only, the important ones of which are as follows:—

Washing plant.—All raw sugar is washed here, and the first separation is made into high and low products.

Blow-up tanks.—Here the washed sugar and the syrup washings are treated with phosphoric acid, lime, and diatomaceous earth (kieselguhr), preparatory to clarification.

Sweet-water evaporators.—The immense volume of washings from the filter-bags and presses, and from the char filters, makes a body of thin sugar solution always acid and extremely liable to further souring.

WASHING PLANT.

In the washing plant the raw sugar is mixed with water to the proper consistency, a portion of the mixing water being sweet water, while milk-of-lime is also added. The magma is thus a composite of several elements: sugar, water, sweet-water, and lime, a mixture whose condition of acidity bears no simple relation to that of the original sugar. After separation in centrifugals, the sugar and syrup travel different ways.

Sugar in process may be divided into two groups of materials:—

Main products.—These include all highly crystallizable solutions light in colour, of purity above 80°, from which are obtained sugars for consumption. They can be tested both with the potentiometer and with chemical indicators. As a rule they act more quickly with indicators, being often sluggish with the potentiometer, since neutral organic substances of high purity do not ionize to any extent and so do not supply a powerful electrolyte. These high-grade sugar liquors, having been neutralized with lime at the beginning of the process and treated from time to time with a neutral defecant like diatomaceous earth, hold their neutrality throughout.

Secondary products.—These are the washings containing the less crystallizable substances darker in colour and of a purity below 80°. They are too dark in colour to give satisfactory colour reactions; but, being better electrolytes, they are quite active when tested with the potentiometer. They are less stable in composition, being a composite of many organic substances, and are peculiarly liable to fermentation, with formation of organic acids and consequent ionization.

A survey of the main products would begin with the melted washed sugar, or first liquor, and would observe the phenomena of ionization which attend it thenceforth. Washed sugar in solution of a density of 55–60° Brix is quite stable during the period of refining. The condition of safety is a pH limit of 6·4 to 6·8, just within the acid range. This condition prevents inversion from excess acid, and also prevents darkening of colour which is liable to occur in alkaline solution. After filtration through bone black containing free calcium carbonate, the pH figure may sometimes rise to 7·0. Under normal working conditions, successive boilings and filtration do not reduce it appreciably below 6·4. Whatever inversion takes place is produced by heat. A sugar liquor above 90° purity, showing a pH figure less than 6·2, is abnormal and requires investigation.

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[1] Paper presented to the Division of Sugar Chemistry at the 64th Meeting of the American Chemical Society, Pittsburgh, Pa., September, 1922.

All this applies to sugar in process, where the material in hand is not kept standing untouched more than 72 hours. Tests of standing liquors and syrups have been made to see when deterioration begins to set in. First liquors and syrups which had been boiled and refiltered, having a purity of 93–98°, and showing a pH figure of 6·8, after 6 days' standing showed little change, in no case being below 6·4. Syrups for soft sugars, from 90-93°, showed some tendency to sour, the pH value falling below 6·0 in some cases. The colour indicators found most useful were those of CLARK and LUBS,[1] several of them having overlapping ranges which can be used to check one another.

BLOW-UP TANKS.

The first of the secondary products is the green syrup from the washing of the raw sugar. Of all refinery materials it is the most unstable, consisting of all the most fermentable substances occurring in the cane, and is invariably in a state of more or less active fermentation. It is sent to defecating tanks, where it is treated with phosphoric acid, lime, and diatomaceous earth. Here there is a direct relation to the preceding state. The only change in the consistency of the syrup is that produced by the defecating agents, one of which is acid and one alkaline. A part of the lime neutralizes the phosphoric acid, and the remainder combines with the organic acids of the syrup, as well as with the gums and other organic matters. Since the lime is not added to excess it does not show ionization. It is considered good practice to keep the treated syrup on the acid side, showing a pH figure of 5·0 to 6·0·

ZERBAN[2] has shown that the neutralization of lime and acid with formation of insoluble compounds produces its clarifying effects by mechanical rather than by chemical means, since it matters little whether the lime compounds are formed by adding lime first or acid first. A neutral, insoluble compound is not to be regarded as ionized, so that chemical effects are here less important than physical effects. Practical sugar making, it is to be remembered, is only incidentally a chemical process. The main process is physical and mechanical, and is only chemical in its testing and in its aberrations.

It is in this washed sugar syrup that we find the most contradictory phenomena. After treatment with phosphoric acid and final lime neutralization, we commonly have a good clarification with a pH figure of 5·0, or slightly over. But sometimes a persistent cloudiness manifests itself, which is unresponsive to changes in application of the clarifying agents, even to the point of neutrality. We have here an effect produced by colloidal matters which seem to have a different electrical condition, preventing precipitation at the ionization figure usually workable—that is, 5·0 to 6·0—and continuing in dispersion until a pH figure of 6·5 is passed. In what manner these colloids may be influenced by the state of ionization of the sugar solution, or what may be the critical point of precipitation expressed in these terms, is yet to be determined. Colour indicators are impracticable in mixtures as dark coloured as these. The average pH values of its reactions at various stages may be stated as follows :—

Green wash syrup	3·6 to 4·0
After defecation and clarification	5·0 to 5·6
(On three day's standing this may fall to 4·0 or below)	
After boneblack filtration	5·6 to 6·0

Through successive boilings and filtrations this syrup from washed sugar becomes as stable as the high-grade products, in fact, even more so as the final molasses stage is reached.

[1] *I.S.J.*, 1923, 88, [2] *I.S.J.*, 1920, 643, 699.

SWEET-WATER EVAPORATORS.

The chief remaining by-product in the refining process is sweet-water, the immense volume of washings from the presses, and the bag and char filters. In the thin state this is as fermentable as washed sugar syrup. On concentration it shows many of the same characteristics, containing all the gummy and nitrogenous substances deposited by the raw sugar during clarification and decolorization. Addition of lime after concentration reduces the acidity to a point still within the acid range. Having been subjected to repeated heating, it is partially sterilized, and so shows less tendency to fermentation upon standing. A sweet-water concentrate in its several stages would show pH figures of the following range :—

After concentration	4·8 to 5·0
After liming and defecation	5·0 to 5·8
After boneblack filtration	5·4 to 6·0

The best refining practice tends to make active ionization a residual phenomenon. A working range throughout would be safe between pH 4·0 to 6·8, and need not exceed these figures. Colour indicators will be found highly useful in testing high-grade sugar solutions; while the potentiometer will be best for secondary products.

Patent Rights for the Pre-Crusher of the Fulton Iron Works Company upheld in Cuba.

Patent rights of the Fulton Iron Works Company, of St. Louis, to the pre-crusher as an invention for the grinding of sugar cane have been signally sustained in Cuba by a recent decree of President ZAYAS, in which an appeal from the decision of the Secretary of Agriculture, Commerce and Labour, refusing to grant the application for a similar patent filed in behalf of the Hooven, Owens, Rentschler Company, is denied.

The decree announcing the decision of President ZAYAS, dated May 25th, 1922, and published in the *Gazetta Official* of Cuba on June 9th, reviews at some length the provisions of the Cuban law as bearing upon the case under consideration, and sustains the Secretary's decision on the ground that, while concession of the patent asked for by the second applicant would not interfere with the first patentee's privilege of seeking redress in the courts for any infringement of rights, the petition must be denied because of the Government's duty to protect the rights it has already granted.

The application for a patent in the name of the Hooven, Owens, Rentschler Company was filed October 31st, 1919, and on July 3rd, 1920. The expert assigned to investigate reported the existence in the Goverment archives of the record of a Cuban patent already granted to and assigned to the Fulton Iron Works Company, and a United States patent, No. 1,291,095, filed in the name of the Fulton Iron Works Company, by assignment.[1] The Secretary thereupon, in a decision of July 16th, 1920 refused the application. An appeal was taken by the applicants on September 27th, 1920, under the law enacted in 1833 which still governs the granting of patents in Cuba, and was denied in the Presidential decree recently issued.

The United Kingdom patents relating to the Fulton pre-crusher are : 146,280; 165,948, and 175,903.[2]

[1] *I.S.J.*, 1919, 471. [2] See *I.S.J.*, 1921, 57; 1922, 53; and 1922, 385.

Prevention of the Deterioration of Raw Sugar by Inoculation with Torulæ.[1]

By WM. L. OWEN.

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Introduction.

Unfortunately raw sugars are comparatively hygroscopic, absorbing moisture very readily. Having once begun to do so, the increase in their water content becomes accelerative, so that after a time their deterioration proceeds with great rapidity. In view, therefore, of this tendency of sugars to absorb moisture, the prevention of their deterioration will have to depend, either upon ideal warehouse conditions, or else upon so changing the composition of the molasses film surrounding the crystal that it will no longer be suitable for the growth of mould fungi, even though its density might be conducive thereto. The first condition is almost impracticable in most countries where raw sugars are made, since there high humidities are usually prevalent; and to store sugars under conditions where this humidity could be entirely counteracted would be prohibitively expensive. The solution of this problem will, in the writer's estimation, result from an attack from the other direction, viz., making the molasses film less inviting to the invading mould. The purpose of the present paper is to show the possibilities of the use of torulæ as a means for the prevention of deterioration.

Nature of Torulæ.

Torulæ are frequently present in raw sugars, and their activities are entirely confined to the fermentation of the invert sugar present, tending, therefore, to increase the polarization by fermenting almost exclusively the levulose with the evolution of carbon dioxide. Unlike the mould fungi, their growth is not restrained by the density of the medium, and they develop in the heaviest blackstrap. By fermenting the invert sugar in the molasses film surrounding the raw sugar crystal, and thus lowering its density, it might be supposed that they would thus provide conditions favourable for the deteriorative action of the mould fungi. But in an investigation carried out several years ago to determine this point, we found that the action of this torulæ, far from proving of advantage to the mould fungi, actually restrained their activities entirely. Many experiments carried out since have suggested the fact that torulæ have a protective action on raw sugars, so as to be capable of preventing their deterioration under certain conditions.

Experiments on the Protective Action of Torulæ.

In one of these experiments a test sugar was prepared in the laboratory from a magma made from standard granulated and a high-grade cane syrup. One portion, however, was made with syrup which had been inoculated with a syrup culture of a torulæ, and had been allowed to ferment for four days at about 34° C. These two sugars were divided into 200 grm. lots, placed in Erlenmeyer flasks, inoculated with cultures of *Aspergillus repens* and *A. niger*, and maintained in an incubator for one month, and at the end of which time they were analysed. As shown by the results obtained, the difference in the behaviour of the two sugars is very striking. In the series in which the film of fermenting molasses was present, no deterioration could be detected (except in one case, and there the difference might be attributed to experimental error), though the factor of safety

[1] Abridged from an article published in *Sugar*, 1923, 117-119; 177-179. For previous literature on this important subject consult: BROWNE, *I.S.J.*, 1918, 226, 265, 319, 370. OWEN, *I.S.J.*, 1919, 227, 334, VAN DER BIJL, *I.S.J.*, 320, 482, 504. TEMPANY and De CHARMOY, *I.S.J.*, 1922, 463, 527.

of both series indicated that they were very susceptible to deterioration. Indeed, in the series in which torulæ were not present, the loss of sucrose amounted to about 6 per cent. (on dry matter). In a number of other tests these results were fully confirmed. In one experiment varying quantities of torulæ were introduced, conditions being generally the same as previously, except that some of the flasks were provided with safety bungs to allow the CO_2 formed to escape. Analytical figures were obtained again showing that where no torulæ were used, deterioration was pronounced; that where a comparatively large amount of torulæ culture had been added, no alteration had occurred in any case; and that where a smaller amount of torulæ culture had been used for the inoculation, inversion by the moulds was correspondingly decreased. Apparently the protective action of the torulæ was just as adequate whether open or closed flasks were employed.

Explanation of the Protective Action of Torulæ.

Two explanations may be suggested for the protective action of the torulæ: (1) That they may utilize nutrient material required by the mould fungi; or (2) that they may form products having a toxic effect on the other organisms. The latter appears the more plausible one; because if the moulds were inhibited only by the exhaustion of their food supply, they would show unhampered activities at the beginning of the incubation period, so that some deterioration would always result from their presence. But our experiments have shown that this is not the case, and that the explanation must be sought elsewhere.

The most obvious inference from the preceding experiments is that the CO_2 produced by the torulæ restrains the activities of the mould fungi, and in this way protects a raw sugar from deterioration. In fact, this gas may be regarded as the weapon by means of which yeast spores are enabled to protect themselves against the invasion of their environment by other micro-organisms. Its effect upon micro-organisms has been studied by FRANKEL,[1] FRANKLAND,[2] LOPRIORE,[3] KIDD,[4] and WM. BROWN.[5] The last-named in his recent splendid work established the fact that the mould fungi are effected by CO_2, that its inhibiting action differs with the different species, and that it differs with the same species in nutrient solutions and in water. In the case of *Aspergillus repens*, the most active of the species occurring in deteriorating sugars, the concentration of CO_2 required to prevent growth at 15-18° C. was found to be 40 per cent.

Effect of an Atmosphere of CO_2 on Growth of Mould Cultures.

To examine this point, further experiments were made on the growth of mould fungi in sugars contained in flasks having an atmosphere of carbon dioxide, these being placed in an incubator during a month, together with a second series of flasks containing sugars in contact with air under ordinary bacteriological conditions. Analytical results were obtained showing that the CO_2 effectively prevented the sugars from deteriorating, where the samples unprotected by this gas suffered rapid deterioration.

In these and in the previous experiments, the action of CO_2 as supplied naturally by the torulæ, or artificially from outside sources, in restraining the most active fungi from causing the deterioration of sugars has been demonstrated. It seemed of interest to ascertain whether any benefit would result from the carbonating of the magma before separating the crystals of sugar. Therefore a magma was prepared from standard granulated and cane syrup, thoroughly carbonated during one hour, after which the sugar was separated in a centrifugal,

[1] *Zeitsch. f. Hyg.*, 1889, 18, 22. [2] *Ibid.*, 1889, 13, 22. [3] *Ann. Botany*, 1922, 36, 257.
[4] *Proc. Royal Society*, 1914, B., 97, 408, 609. [5] *Ann. Botany*, 1922, 36, 257.

placed in a series of flasks, and inoculated as before, a second series of flasks containing sugar made from uncarbonated magma being prepared in the same way. After a month results were obtained showing that, provided the magma was sufficiently viscous to retain the CO_2, this method of working was effective in preventing deterioration during this period.

Investigation of the Effect of Drying on Inoculated Sugars.

One is led to enquire if, as the consequence of drying the sugar by heating it, the torulæ would survive the effect as well as the mould fungi, that is to say, whether a sugar which is well inoculated with both moulds and torulæ at the time of manufacture, and therefore well protected against deterioration for the time being, would be equally well protected after being in storage for several months with the loss of part of its moisture. Mere drying, of course, makes a sugar less susceptible to deterioration, but we are now referring to the potential tendency of the sugar to deterioration if later it should re-absorb moisture. A sample was prepared in the laboratory from standard granulated and cane syrup as a control sugar. Another sample was prepared in a similar way, but the cane syrup had previously been inoculated with torulæ (345,429 per c.c.); while a third sample was made in the same way as the control sugar, but the magma was carbonated (as in the previous experiment). Then each of these three lots of sugar was divided into two portions, one of which was introduced into flasks and inoculated, and the other dried for 12 hours at 50°C. However, the results of this series of tests showed conclusively that, while the activity of the torulæ did not prevent deterioration, at any rate its alteration was decreased to a very marked degree; carbonating had a similar effect. Yet the syrups from this sugar were entirely protected by the torulæ, while carbonating had also prevented any very appreciable action of the moulds. Now, what is the explanation of the difference in the results with the syrup as such, and with the same syrup when distributed as a film around the crystal? Simply that the syrup in deep layers can retain sufficient CO_2 to check the growth of the mould. This was demonstrated in a further similar series of tests, in which, in place of syrup, dense and viscous molasses was used, it being then found that deterioration of the sugars made with molasses inoculated with torulæ was very much less than before, in fact was noticeable only in one case.

In the tabulation of the results obtained in the experiments just described[1], the number of torulæ per grm. of sugar was stated, which figures are of considerable significance, because they explain a point which has tended to confuse many of us who have studied the problem of sugar deterioration. A bacteriological analysis of any of these samples might lead one from purely quantitative considerations to regard the torulæ as the most important group of micro-organisms concerned in the deterioration of sugars, and the latest to draw such a conclusion appears to be Tempany and De Charmoy, who state[2] that the organisms found in deteriorated sugars consist of moulds, bacteria and torulæ; and that of these "torulæ are probably the most destructive agents under Mauritius conditions."

Number of Torulæ Providing Protection.

There is another phase of the study of these figures obtained in the experiments cited that should be discussed. It was noted that, at the end of the experiment, the sugars in Series I contained 251,264; in Series II 92,960 and 25,800; and in

[1] As given in the original article. [2] *I.S.J.*, 1922, 265.

Series III 31,800 torulæ per grm., while Series I contained 29,785 at the beginning of the experiment. What do these figures show? They indicate that, at the end of the one-month storage period, Series II and III were then as well protected from further deterioration as Series I was at the beginning of the experiment. In other words, torulæ protection against mould action must be capable of exerting itself comparatively vigorously at the very beginning of the storage period. That means the torulæ inoculation must take place at the time the sugar is made. Now the reason that all sugars are not as well inoculated with torulæ when they leave the centrifugals as they are with mould fungi is obvious. Neither mould nor torulæ survive the temperatures in the vacuum pan, but mould spores are much more easily conveyed by the air currents coming into the centrifugals than torulæ are. The nature of the source of infection of sugars during manufacture has been thoroughly investigated; and it has been shown that the mould fungi are the predominant group of micro-organisms in the air about centrifugals in the average sugar-house. It is interesting, in this connexion, however, to note that there are some factories where the conditions seem to be especially favourable for torulæ infection, for the sugars produced there always increase in polarization during storage, as a result of the fermentation of the reducing sugars present.

General Remarks on Protective Action of Torulæ.

It may appear strange to those who have studied the problem of sugar deterioration from an industrial standpoint to associate any protective action with a type of fermentation that they have regarded as indicative of the active deterioration of sugars. In the literature we find the physical characteristics of deteriorated sugars usually described as "moist," and having a "rum-like odour." It has become a custom to associate deterioration with these characteristics of sugar, because these easily described characteristics frequently do apply to such sugars. But in the light of what this investigation has shown, deterioration in such cases had probably started, and had been arrested by the very fermentation the characteristics of which are now used to describe the fermentation itself.

There is one other phase of the protective action of the torulæ against sugar deterioration that should be mentioned. We have referred to the fact that the action of these micro-organisms upon invert sugars is a selective one, and levulose is used up before the dextrose. The result of this selective action is to increase the polarization of the sugar by approximately 1·4 per cent. for every 1 per cent. of levulose destroyed. Hence for every one lb. loss in weight from the liberation of CO_2 we would have a gain of nearly 3 per cent. in polarization; or, in other words, the sugar would have improved in refining value during storage far more than sufficient to offset the loss in weight.

Future Work on Torulæ Inoculation.

This investigation is to be continued to determine the following points:—(1) The most suitable torulæ to use in the inoculations of sugars. (2) The effectiveness of torulæ under industrial conditions of storage. (3) The survival of the torulæ during long periods of comparative dryness of the sugar, while it conforms to the factor of safety and before it absorbs moisture. (4) The lower limits of density in which the torulæ can successfully restrain the development of the mould fungi. (5) The best methods for inoculating sugars on an industrial scale.

According to a report of the Department of Overseas Trade, the Czecho-Slovak beet sowings for this year cover some 219,500 hectares, as compared with 184,590 hectares in 1922.

Department of Overseas Trade Reports.

BULGARIA.

The production of sugar in Bulgaria has always left much to be desired. The five sugar factories existing in this country have never been able to work to their full capacity, largely owing to the reluctance of the peasants to grow the necessary beet. The tactics of the latter in demanding for their beet more than the industry can afford has resulted in many disputes between them and the sugar factories, so that last year an area of 90,000 hectares only has been cultivated instead of the 120,000 cultivated in 1921. In order to enable the factories to work at their full capacity it is estimated that a minimum of 250,000 hectares should be given over to beet cultivation. The production of beet in 1922 was 100,000 tons, which gave 15,000 tons of sugar. This amount is not sufficient to meet local needs, which are estimated to amount to about 35,000 to 45,000 tons annually. Bulgaria is therefore compelled to purchase the balance from abroad, principally from Czecho-Slovakia, Germany and America.

HOLLAND.

Several Dutch beet sugar factories were closed down during 1922; this may be solely ascribed to the fact that the principal sugar producers are now grouped in the Central Sugar Company which has a working agreement with the Co-operative Beet Producers' sugar factories. From this year's operations 275,000 tons of sugar may be expected, which still is 50 thousand tons over and above the total requirements of the country, including the exports of any sugar-containing articles.

Some of the factories of the Central Sugar Company have lately encountered difficulties with the farmers with whom they had contracted for the supply of beet during a number of years, but these differences have now been settled on a satisfactory basis. The profits from the centralization of the sugar industry in the Netherlands have, nevertheless, not been equal to expectations, and arguments have been put forward to prove that such profits as have been made are due to speculation on the part of the managements, and that the trust is over-capitalized.

The production by beet sugar factories of raw sugar and consumable sugar, reckoned as white sugar, from January to November, 1922, inclusive, amounted to 174,888 tons; the total production by beet sugar factories and refineries of consumable sugar from January to November, 1922, inclusive, to 151,910 tons. Sugar brought into consumption during the above-mentioned period amounted to 192,967 tons, and stocks withheld from consumption in the same period totalled 27,965 tons.

Sugar beets were on average in good condition. The early frosts in September and October gravely endangered the crops which had been lifted. However, as these frosts did not continue, the effect is not expected to have been serious. At any rate, although the area under cultivation was below that of the previous year, namely, 58,000 hectares against 75,000, the sugar production for the year was still expected to exceed the requirements of the country.

ANGOLA.

In Angola, sugar cane is largely grown in the marshy land near rivers. Up to 1911 its cultivation was undertaken mainly for the production of spirits, for which there was a great demand among the natives. By a decree of May of that year, however, the indiscriminate manufacture of alcohol was prohibited and a loan of 3,000,000 escudos was raised to indemnify planters on the basis of the area they had had under sugar cane. Planters entitled to compensation received 30 per cent. forthwith and the remaining 70 per cent. when they had brought the areas under other crops. Those owning or installing sugar mills, or sending their cane to a mill for three years following the decree, were similarly compensated, provided they increased the area they had under sugar cane by one hectare for every 500 escudos received. The immediate effect was to increase the production of sugar, the export of which in 1913 was three times what it had been in 1910. Since then there has been a more or less steady increase.

The Companhia de Assucar de Angola, with a capital of 10,000,000 escudos and estates covering a total area of 35,000 acres at Dombe Grande and Luacho, near Benguella,

and on the Dande river, north of Loando, is the most important sugar-producing concern in the country. It has two mills, each producing 3000 tons a year, which are being adapted to a much larger output. There are also large plantations at Bom Jesus, on the Cuanza river, belonging to the Companhia Agricola do Cazengo; at Cassequel, in the Benguella district, belonging to the Sociedade Agricola de Cassequel; and at Nova Redondo and Mossamedes.

FINLAND.

All the sugar refineries in Finland belong to the Finnish Sugar Company, which has increased the production of refined sugar from 25,800 tons in 1921 to 33,700 tons in 1922. A factory for the production of raw sugar from home grown beet also exists, but it is only in an experimental stage. The quantity of sugar production in the country is still far from sufficient to meet the internal demand and large quantities have to be imported from abroad.

The 1922 Java Sugar Crop.

The Figures of Sugar Exportation, April-March, 1922-23.

TONS OF 2240 LBS.

DESTINATION.	1918-19.	1919-20.	1920-21.	1921-22.	1922-23.
Netherlands	—	21,283	9,804	10,222	32,528
Belgium	—	—	7,396	—	2,702
United Kingdom	142,547	119,528	50,642	9,124	102,069
France	55,536	41,636	10,013	10,124	83,957
Germany	—	—	—	104	13,023
Switzerland	6,528	—	—	—	—
Russia and Finland	2,958	1,414	10,922	4,000	11,261
Denmark	—	2,370	—	681	26
Sweden	—	14,522	27,807	—	—
Norway	44,272	50,152	31,008	—	2,322
Italy	5,495	45,956	18,166	33,502	8,865
Portugal	—	—	1,000	—	—
Spain	—	6,919	3,004	—	—
Greece	5,162	8,239	5,907	5,875	9,610
Rumania	—	3,921	3,070	3,756	—
Servia	—	—	—	951	2,256
Turkey	—	23,231	2,174	9,049	11,664
Egypt	2,844	—	—	4,810	22,638
Smyrna	—	—	—	—	5,498
Suez	28,870	11,083	11,843	8,018	175
Port Said, f.o	19,438	56,041	353,630	48,626	136,230
Argentina	5,200	—	—	—	—
United States	7,423	—	237,162	300	—
Vancouver	17,656	2,953	—	5,020	7,000
Singapore	163,230	64,568	41,450	70,041	60,780
China	31,961	3,525	3,765	32,638	30,751
Hong Kong	308,792	184,422	171,398	319,126	258,513
Japan and Formosa	439,396	272,187	94,473	353,787	279,883
British India	343,480	336,000	212,562	625,909	440,538
Australia	30,000	82,718	63,362	5,447	4,435
Siam	3,612	3,428	2,358	3,565	17,650
Other countries	100	3,152	644	20	2,802
Total	1,664,500	1,359,348	1,373,560	1,564,695	1,547,176

Brevities.

It is reported[1] that experiments are being conducted by the Formosa Hydro-Electric Power Co. on the extraction of sugar from cane by the electro-osmose process, which is claimed to give a very pure juice, and to effect a considerable saving in the cost of making white sugar directly on the cane plantation.

The sugar crop in Brazil for 1923-24 has been officially calculated at 10,673,500 bags (of 60 kg.), Pernambuco accounting for 3,000,000 bags, Minas Geraes 2,800,000 bags, and Rio de Janeiro 1,200,000 bags. The crop is thus expected to equal 640,410 metric tons, a figure that if attained will prove easily a record for Brazil's sugar industry.

The Corn Products Refining Company has appointed a Research Associate to be stationed at the Bureau of Standards, Washington, which post has been accepted by Dr. H. Berlin, who during the war was chief of the research division of the E. I. du Pont de Nemours Company. He will engage in research on sugar and starch at the Bureau of Standards.

This year 16,000 acres of sugar beet or double the amount grown last year are being cultivated by farmers in the English midland and eastern counties for the two existing beet sugar factories at Kelham and Cantley. This season the price for the roots is to be based, not only on the sugar content as last year, but also upon the average sale price of sugar realized by the factory.

Dr. R. B. Moore, formerly Chief Chemist and Mineral Technologist of the U. S. Bureau of Mines, has been appointed to the charge of the development of the Dorr Company Engineers. Dr. Moore is a technologist of the first rank, one of whose many achievements was the design, construction, and operation of three helium plants during the war. The Dorr Company is to be congratulated on this important addition to its staff.

In 1920 the Martel Apparatus Co. contracted to supply a filter installation to the Lafayette Refining Co., of Louisiana, this including five presses guaranteed to handle the juice from 1000 tons of cane per day, the price of the equipment being $20,000. The plant was alleged to be a failure; and, as the result of an action brought by the Martel Apparatus Co , judgment was awarded to the refining company, authorising them to collect a payment which had already been made.

Laboratory experiments made by several investigators[2] on manuring with carbon dioxide have given very promising results, the success which on the small scale has attended this method being attributed to the fact that, during the growth of a plant in an atmosphere richer in CO_2 than ordinarily, the nutrients (whether from manures or from fertilizers) are better absorbed from the soil. Dr. Riedel, by leading CO_2 from kilns over fields in which beets and potatoes were growing, has stated that an increased yield in the proportion of 150 : 100 was obtained.

We learn that Dr. S. C. Harland has been appointed Professor of Botany in succession to Mr. T. J. Mason, at the Trinidad Agricultural College. Dr. Harland is very highly thought of in Lancashire, where he has recently filled the important post of Head of the Botanical Department of the British Cotton Industry Research Association. He was previously for some years Assistant Superintendent of Agriculture in St. Vincent, and is a scientist of marked ability and originality. In this connexion it may be pointed out that the Governing Body of the College attach great importance to research work, and it is proposed that the research laboratories in the new building shall be very fully equipped.

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[1] *Production and Export*, June, 1923.

[2] *Die Umschau*, 1923, No. 12. See also Bornemann, "Kohlensäure und Pflanzenwachstum," Berlin, 1920; Fischer, "Kohlensäure und Pflanzen," Stuttgart, 1921.

Review of Current Technical Literature.[1]

COMPARATIVE YIELDS IN THE MANUFACTURE OF WHITE AND RAW SUGARS. *Irving H. Morse. La. Planter, 1923, 70, No. 9, 168–169.*

In Louisiana during the 1922-23 season, several of the large manufacturers who for years had been making a good grade of white sugar reverted to the production of raws, the reason stated for their action being that there was little demand for whites, and that they were thus obliged to store it at considerable expense, later to take their chance of selling it on a falling market. There are no doubt many others who will seriously consider abandoning the production of whites, and avoid going back to the custom of a decade ago. Before doing this, the yields of white and raw sugars, their costs of manufacture, and the prices which may be expected for each, should be studied. In order to assist in the compilation of such calculations, and thus decide which procedure will give the greatest profit, a series of yields is here stated, and the author remarks that if each producer will take these figures as a basis, and work out from his time book, pay roll, and supply invoices the cost of each, and will compare the values obtained with the broker's prices at any date, he will be better informed as to the advisability of turning out white or raw sugar during any season. It is assumed that there are six factories all grinding cane of comparable quality, that all the mills give identical results in respect of extraction, that the juice has the same composition, that clarification in every case increases the purity 1°, that in all the loss of sucrose averages 3 per cent., that, therefore, the same quality of syrup is made in all six factories, and that the results by different methods of boiling are strictly comparable throughout. Further, the following data, based on the yield from one ton (2000 lbs.) of cane are assumed: analysis of normal juice, Brix, 15·00°, sucrose, 12·00 per cent., and purity 80°; weight of juice, 1500 lbs.; solids in juice, 225·00 lbs.; sucrose in juice, 180·00 lbs.; analysis of syrup, Brix, 54·3°, sucrose, 43·98 per cent., purity, 81·00°; weight of syrup, 396·98 lbs.; solids in syrup, 215·56 lbs.; sucrose in syrup, 174·60 lbs. *Factory A.*—This makes raw sugar, using the 2-massecuite system, reducing the molasses to 33°, which molasses is re-boiled, and left in magma tanks for curing in the summer months, the yields in which factory being as follows: raw sugar, 96°, 163·63 lbs.; third sugars, 90°, 6·47 lbs.; and black-strap molasses, 5·15 gallons. *Factory B.*—This produces a straight strike of syrup, resulting in white sugar and molasses, 50 per cent. of the solids being assumed to be recovered in plantation granulated, and the molasses being boiled to 42° Bé, cold, the yields in which factory are as follows: plantation granulated, 107·78 lbs.; and first molasses, 11·87 gallons. *Factory C.*—This makes plantation granulated with a 2-massecuite system, and a "boilback" molasses of 45° purity, the recovery of solids in the massecuite being 65·47 per cent., as follows: plantation granulated, 141·11 lbs.; and "boilback" molasses, 8·20 gallons. *Factory D.*—This works in the same way as in the previous example, but instead of selling the "boilback" molasses, it is re-boiled into second massecuite, and the second sugar and second molasses sold, the yields being as follows: plantation granulated, 141·11 lbs.; second sugar, 90° test, 15·48 lb.; and second molasses, 6·53 gallons *Factory E.*—Here the same method is followed as far as the boiling is concerned, but the second sugars are melted up and made into plantation granulated, and the following yields obtained: plantation granulated, 154·43 lbs.; and second molasses, 6·73 lbs. *Factory F.*—In this case the same method of boiling is followed as in Factory A, but all the raw sugars are melted up, the liquor filtered with the addition of decolorizing carbon or char, re-boiled, and turned into granulated and refinery syrup with the following yields: granulated, 151·36 lb.; third sugar, 6·47 lbs.; refinery syrup, 1·23 gallons; and blackstrap molasses, 5·15 gallons. In calculating these yields, no account has been taken of any chemical or mechanical losses after the syrup enters the pans, and it has been assumed that

[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*, 298.

all the solids and sucrose can be accounted for in the final products. Therefore, they are purely theoretical; but, nevertheless, are put forward for guidance in the computation of costs on the lines above suggested.

A NEW BASIS FOR COMPARING MILLING RESULTS AND BOILING HOUSE RECOVERIES. *E. W. Kopke. Sugar News, 1923, 4, No. 3, 108-110.*

There are five basic factors involved in the determination of the mill extraction, three of which are entirely beyond the influence of the factory personnel. These "outside conditions" are the fibre in the cane, the sucrose in the cane, and the purity of the juice. The two figures indicating the milling results, or the "inside figures," are the sucrose (or polarization) in the bagasse and the moisture in the bagasse. The actual extraction of sucrose in the cane, which is determined daily, and which constitutes an important figure, is largely influenced by the outside conditions, so that an actual improvement in milling practice may show a lower extraction, or relatively inferior milling may show up to unfair advantage. In order to come to a basis of fair comparison and obtain a figure which is free from these disturbing variables, it is only necessary to substitute constants for the sucrose in cane, the fibre in cane and the purity of the residual juice in the bagasse. The milling efficiency figure, as adopted by the 1921 Conference of Sugar Men at Bacolod, P. I., involves the following constants: 11·0 per cent. fibre in cane, 13·0 per cent. sucrose in cane, and 70·0° purity of the last expressed juice.[1] The actual polarization and moisture in the bagasse are included in the calculation which is exactly the same as for the determination of the mill extraction. In other words the milling efficiency is practically the extraction which would have been realized had the cane been of the standard or constant quality mentioned and the same polarization and moisture of bagasse applied. Then a mill handling a cane of inferior quality as compared to this standard quality cane will show a higher mill efficiency than the extraction, and when handling a superior quality cane the mill efficiency will be lower than the extraction. It would appear, therefore, it is concluded, that the mill efficiency figure constitutes the fairest basis for judging the milling results.

In the boiling house the quality of the juice has a much greater influence on the recovery and losses than is the case at the mill. A difference of 10 per cent. in the purity of the juice may make a difference of 100 per cent. in the boiling house losses even with the same purity of final molasses. The main objective in the boiling house is to realize the maximum recovery of crystallized sugar which means the greatest possible exhaustion of the final molasses. The purity of the final molasses does not convey a very definite idea to the average sugar man so far as the relationship to recovery is concerned; and for this reason, as well as for the purpose of establishing a more definite and significant figure for comparison, it is important that the variables which are beyond the control of the boiling house personnel be substituted by constants, and that the quality of the molasses be expressed as the ratio of "accomplishment to possibility" but involving a standard purity of juice (adopted as 86·0 for the boiling house efficiency) while assuming 30·0° gravity purity as the maximum possible degree of exhaustion for the final molasses. The ratio of the recovery corresponding to the attainment of a 30·0° gravity purity molasses, and that corresponding to the actually realized quality of molasses (with an 86·0 purity juice in each case) constitutes the boiling house efficiency. A number of arguments have been advanced for and against this standard basis for comparison. Naturally those factories showing a low loss figure or very excellent recovery due largely to the very favourable cane and juice conditions, do not make as good a showing on the efficiency comparison. The actual recoveries and losses are often very misleading and unfair as a basis for judging the work of a factory, but this efficiency standard gives a more correct idea of what is being accomplished. In this case the standard is fair for all.

[1] See also *I.S.J.*, 1922, 99.

CHEMICAL CONTROL REPORT OF THE LA CARLOTA SUGAR CENTRAL, P.I. *H. Gifford Stower. Published by the Central Azucarera de la Carlota, Negros Occidental, Philippine Islands.*

Mr. STOWER, General Manager at La Carlota, submits the following final chemical report, showing the figures obtained during the past three crops:—

	1920-1921.	1921-1922.	1922-1923.
General Data—			
Cane ground in metric tons	161,700	222,548	220,754
Sucrose per cent. in cane	13·55	13·23	14·13
Fibre per cent. in cane	11·80	10·50	11·38
Tons cane per ton sugar due cane	8·57	8·39	7·61
Piculs sugar per ton of cane	1·83	1·89	2·08
Sugar manufactured—			
Polarization per cent.	96·33	96·45	96·46
Moisture per cent.	1·10	1·03	1·01
Coefficient of safety	0·33	0·29	0 29
Commercial sugar per cent. cane	11·67	11·92	13·15
Tons (metric)	18,861,609	26,537,826	29,025,253
Lime used—			
Kilos per ton cane	1·30	1·69	1·01
Bagasse—			
Polarization per cent.	5·17	3·60	2·88
Moisture per cent.	51·5	49·31	48·22
Press Cake—			
Polarization per cent.	3·84	1·16	1·47
Final Molasses—			
Gravity solids per cent.	88·3	90·96	89·99
Apparent purity	30·4	32·71	31·20
Gravity purity	..	35·03	34·98
Gallons per ton sugar	45·7	33·79	28·75
Milling Data—			
Extraction per cent. sucrose in cane	92·17	93·72	95·17
Dilution per cent. normal juice	8·50	20·10	24·88
Tons cane per hour	53·4	77·60	92·78
Hours actual grinding	2,720·00	2,867·00	2,379·00
Hours delay due factory	291·00	102·00	91·00
Hours delay due cane	188·00	235·00	257·00
First Expressed Juice—			
Brix	19·1	18·68	19·09
Polarization per cent.	15·6	16·16	16·89
Apparent purity	82·1	86·50	88·48
Last Expressed Juice—			
Brix	4·7	4·37	3·38
Apparent purity	68·8	75·06	77·81
Mixed Juice—			
Apparent purity	79·6	83·55	86·05
Brix	17·2	15·08	14·83
Syrup—			
Brix	64·2	63·68	65·92
Apparent purity	81·4	85·71	87·93
Losses per cent. Sucrose in Cane—			
In bagasse	7·82	6·28	4·83
In press cake	0·64	0·19	0·18
In final molasses	8·73 (with undetermined)	5·53	4·71
Undetermined losses		1·09	0·55

Review of Current Technical Literature.

HAWAIIAN CHEMICAL CONTROL RESULTS (MILLING AND BOILING HOUSE) FOR THE 1922 SEASON. *E. T. Westly.* *Sugar News, 1923, 4, No. 4, 177-178.*

Considering first the varieties of cane milled, Lahaina and Yellow Caledonia are giving ground to H 109 and D 1135. Yellow Caledonia still leads, however, with 40·3 per cent. of the total 1922 crop; H 109 is second with 21·1; D 1135 is third with 12·2; while Lahaina, at one time the leading cane, is now fourth in importance with only 12 per cent. During the year under review, the quality of the cane was poorer than in any other, the following being the figures obtained: average polarization, 12·97 with 14·91 and 10·92 as the maximum and minimum figures; average fibre, per cent., 12·95, the highest recorded for any year, the highest and lowest figures stated being 15·68 and 11·79 per cent.; average purity of the first mill juice, 86·84°, the extremes being 88·9 and 81·4°. Coming next to milling, very high extractions are still being obtained by most of the factories in Hawaii; but the average was not as good as in 1921, and 1922 is the first year since 1911 that does not show an improvement over the preceding season. In 1922, 96·98 per cent. extraction was the average, against 97·43 per cent. for 1921; the highest average obtained by any factory was 98·84 per cent.; five mills record averages over 98 per cent., and 16 over 97 per cent. The lowest milling loss obtained was 1·10; the average milling loss was 3·02, against 2·64 for 1921. One of the main reasons for this drop in recovery at the mill is undoubtedly that less maceration was used; 34·75 per cent. dilution on normal juice is the average for 1922, and 39·30 per cent. for 1921. Less maceration and lower extraction has undoubtedly had its influence on the juice purities, as we find that the drop from first mill to last mill purity during 1922 was 17·71, against 20·33 in 1921, and the drop from first mill juice to mixed juice was 3·11 during 1922, against 3·45 during 1921. As in former years, tons cane ground per hour was very low.

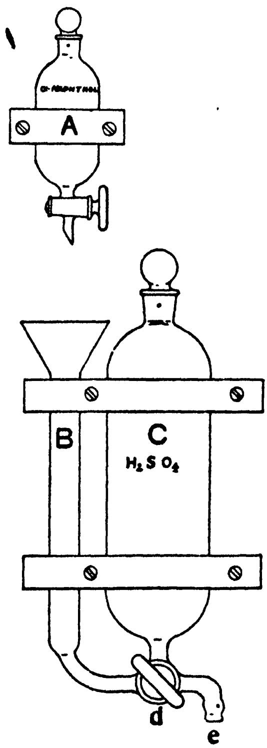
A study of the boiling house work reveals several interesting facts. More lime was used in clarification than previously, and in most cases a better increase in purity from mixed juice to syrup is reported. On the other hand, more mud was obtained, and the polarization of the press-cake was higher than in any previous year for which figures are available. It is the writer's experience that when juice is over-limed a greater volume of settlings are obtained, and consequently the work required of the presses is increased. Several Hawaiian factories practising over-liming during 1922 reported better recoveries. The density of the syrup was higher during 1922 than any previous year, the average figure being 63·37° Brix. No doubt this is due to a great extent to reduced maceration at the mills. Regarding the sugars made, the average polarization in 1922 was 96·88, slightly higher than during 1921, when it was 96·75; while the moisture content of the sugar is coming down from year to year and was 0·87. As to the final molasses, average gravity purity for 1922 was 38·75 against 38·53 for 1921. Notwithstanding the higher molasses purity, the loss of sucrose was less, due to a lesser amount of molasses. This again was due to a higher purity syrup. Undetermined losses are being lowered; the average was 1·27 per 100 sucrose in cane against 1·76 during 1921. A comparison of some of the figures for the last two Hawaiian crops eads to the following remarks:

The polarization of cane is 0·15 lower for 1922, which should give less sugar in the bags. The extraction was 0·45 lower in 1922, which also should tend to give less sugar. Press work was poorer in 1922 (0·91 higher polarization than in 1921), indicating an expected further reduction of sugar recovered in the bag. When we also find that the gravity purity of the final molasses was 0·22° higher in 1922 than in 1921, we would be justified in expecting less sugar recovered, as everything points that way. But what is the fact? In 1922, 87·02 per cent. of the polarization in cane was bagged as commercial sugar against 85·86 during 1921, or 1·16 per cent. more. Why? A higher percentage of the sugar coming to the Hawaiian factories in 1922 was put into the bags, even with poorer factory work, because in 1922 the purity of first mill juice was 0·62°, the mixed juice 0·96°, and the syrup purity was 1·06° higher than in 1921. High extraction is good, so is low polarization of press-cake, and low gravity purity of final molasses, but in the writer's opinion it is of far greater importance to see that the purity of the juice in the cane

delivered to the mill is as high as possible, and that this purity is improved in the factory. The higher the purities, the more sugar will be recovered. High purities automatically increase pan, crystallizer, and low grade centrifugal capacities; they also reduce the amount of labour and materials required, and help to reduce the costs per ton of sugar.

APPARATUS FOR CARRYING OUT THE ALPHA-NAPHTHOL TEST FOR TRACES OF SUCROSE. *Guilford L. Spencer. Journal of Industrial and Engineering Chemistry, 1923, 15, No 6, 593.*

In a well-conducted sugar factory or refinery, the α-naphthol test for detecting traces of sucrose is made with such frequency that the provision of apparatus of greater convenience than the usual test-tubes and pipettes becomes desirable; while furthermore there is always the danger that the glassware usually employed for the test may in some way or other become contaminated with sugar. Therefore, Dr. SPENCER has designed the apparatus now about to be described, which was employed during one season in a large factory, then was modified to correct minor defects, and is now in constant use in five factories in Cuba. As one may see on referring to the accompanying illustration, it consists of a vessel *A* for storing the α-naphthol, another vessel *C* for the concentrated sulphuric acid, and the funnel-tube *B*, in which the sample under examination, the α-naphthol, and the sulphuric acid are brought together. Vessel *A* has a capacity of about 35 c.c. of a 20 per cent. solution of α-naphthol, and is provided with a stopper and run-off cock, as shown; vessel *C* is somewhat larger, its capacity being about 250 c.c., and it is filled with concentrated sulphuric acid, which if it is not colourless should be heated to boiling point before it is used. At *d* is a 3-way cock (marked for position with coloured glass), and at *e* is the outlet tube, which may be connected with a piece of rubber tubing, leading to waste. In order to afford protection from dust, the whole apparatus is enclosed in a wooden case, and it should be so located that the bottom of the funnel-tube *B* is above the level of the operator's eye. In actually making a test (say with a sample of water from the catch-all), distilled water is run through a piece of rubber tubing into the funnel-tube *B* to wash it, the cock *d* being opened to the outlet *e* running to waste, and this being done the subsequent operations are successively as follows: Funnel-tube *B* is washed out with a little of the sample; cock *d* is closed; funnel-tube *D* is filled with the sample; two drops of α-naphthol solution are dropped into the sample in funnel-tube *D* from the vessel *A*; a few minutes are allowed to elapse for the diffusion of reagent and reacting liquid; vessel *C* is filled with the concentrated sulphuric acid; and lastly cock *d* is so rotated as to allow the sulphuric acid to run from vessel *C* into funnel-tube *B* to a depth of about 5 mm. above the bottom of it. Then if sucrose be present in the sample under examination, the characteristic colour reaction will soon be noted at the point where acid and water meet.



BEET SUGAR MANUFACTURE IN EUROPE AND AMERICA COMPARED. George von Strakosch. *Facts about Sugar, 1923, 15, No. 27, 537.*

"Above all, Europe will have to learn how to increase the capacity of her plants, for it is no exaggeration if one says that the average American plant works 20 per cent. more and the European 20 per cent. less than the original capacity for which the diffusion battery was built. Many inventions and methods have been developed in the United

States in recent years; weed, tail and iron catchers; new vertical cutting machines, producing clean and perfect V-shaped cossettes; chain systems to increase the capacity of the battery; automatic heat recorders and pyrometers, enabling the juice temperature to be controlled with accuracy; absolute co-operation between the different stations and the boiler-house, and especially the reduction in the number of labourers and the efficient individual training and co-operation of the supervising staff. It is a true proposition that a sugar factory works the more efficiently the fewer labourers are employed. American plants have also developed a very exact and scientific method of chemical control, thereby greatly restricting the sugar losses and continuously directing the production process in the right way. The average European factory has 50 per cent. more labour power than the American plant of equal capacity, but employs only one trained chemist per shift. Great improvements have also been made here (in the U.S.) in filtration processes. Europe practically uses only plate-and-frame presses, though it is doubtful if the installation of Sweetland or Kelly filters would pay, as their principal advantage is labour saving, and her labour is cheap and plenty. But Vallez filters, as well as Borden or Genter thickeners in combination with vacuum filters for first carbonatation juice, may have a great future in Europe, as they not only save labour, but also restrict the consumption of filter-cloth and coal, and reduce the sugar loss. Many other new machines have been constructed, which the European industry could take over with great advantage, especially in installations for the automatic handling of beets, coal, limestone, and sugar, and the simple and efficient way of constructing new plants, like Brighton (Colorado) and Mitchell (Nebraska). Also the modern boneblack devices, continuous centrifugals, and automatic counting and packing machines used in the cane refineries, should be introduced into the larger beet refineries of Europe. This investigation shows that there is no doubt of the American industry now being far ahead in many ways. . . . . But it would be unjust not to regard the points in which the European industry is still in advance. One of these points is fuel economy. Using coal of 8500 to 9000 B.T.U., the coal consumption calculated on the sugar is 90 to 120 per cent. in America, against only 70 to 90 per cent. which I found in European factories. Of course, the latter only produced raw sugar and have no Steffen houses, but they generally boil down their purer raw juices three times to get down to molasses of about 50° purity. The other point is the agricultural side of the beet sugar ndustry. Although many first-class agricultural experts are working at this question, still very much can be and has to be done in the United States. Through greater use of natural manure, artificial fertilizer, scientific crop rotation, and more intensive culture, both the yield and the sugar content of the beet crops could be greatly improved. Then many of the Californian farmers, who are now deserting beet culture to raise fruits and vegetables, may find that intensive and scientific beet growing is, after all, the better paying proposition."

ABSORPTION SPECTRA OF REFINERY MASSECUITES, MOLASSES, GRANULATED SUGARS, ETC. *H. H. Peters and F. R. Phelps. Paper read before the Sugar Division, American Chemical Society, New Haven Meeting, April, 1923.*

Average samples of the products obtained in boiling granulated sugars in a leading refinery were prepared in the form of concentrated solutions of 52–54 per cent. of dry substance by weight, and filtered over "Powminco" asbestos pads packed in Gooch crucibles to secure transparent filtrates. Then the specific transmissive indices were determined spectrophotometrically. It was found that when pure water-white liquors are boiled to magma under normal pan-floor conditions the absorption is increased about two-fold throughout the visible spectrum. Such an increase gradually diminishes the less the technical purity of the pan-feed, i.e., the greater the admixture of non-sugars, and in the case of the lowest purity pan-feed liquors no colour increase was observed as the result of boiling. In all run-offs, the absorption increases in the blue end of the spectrum, due to the fact that the crystallized sucrose has far less absorption in the blue end than even the best water-white first liquor. Crystallization produces progressive changes in the ratios of absorption for adjacent points of the original absorption curves. During boiling the creation of at least two types of colouring matter is indicated. That the

percentage of colour increases from product to product with pan-feeds and granulateds as sources of comparison is shown for numerous wave-lengths in tables and graphs. Lastly, it was pointed out that systematic spectrophotometric investigations as the source of supply will lead to deeper insight into the causes of colour changes induced during successive stages of manufacture.

COMPOSITION OF NATIVE MALAY COCONUT PALM SUGAR. *H. Lowe and A. Houlbrooke. Analyst, 1923, 48, 114–115.*

Crude coconut sugar is prepared from *Cocos nucifera* by boiling down the juice in iron pans over a wood fire, the syrup obtained being ladled into moulds made from the leaves of the palm coconut. It consists of dark brown granular pieces, cylindrical in shape, the average weight of each piece being about 14·5 grms. It has a pleasant characteristic taste, and its composition was found by the authors to be as follows: Water, 6·07; ash, 2·92; reducing sugars, 3·29; and sucrose, 88·22 per cent., giving a total of 100·50 per cent.[1] Analysis of its ash was found to give the following figures: Silica, 4·32; ferric oxide, 1·80; alumina, 24·20; calcium carbonate, 17·41; magnesium carbonate, 5·30; sodium sulphate, 2·45; sodium chloride, 14·25; calcium sulphate, 24·44; and sodium and potassium carbonates (by difference), 5·83 per cent.

THEORY OF THE ACTIVATION OF DECOLORIZING CARBON. *J. B. Firth. Journal of the Society of Chemical Industry, 1923, 42, No. 22, 242–244T.*

"It would appear that in the preparation of an active carbon, the function of the soluble or insoluble substances mixed with the carbonaceous material before carbonizing is that of a spacing agent whereby the molecular complexity of the resulting carbon is considerably reduced. The carbonaceous material is so distributed that the deposition of carbon at any point is very small. In the case of a soluble carbon compound such as cane sugar mixed with a spacing agent such as kieselguhr, the carbonaceous material is primarily in the nature of a film. Under such conditions it would appear impossible to form a highly complex carbon molecule. Yet under these conditions a highly active carbon is produced. The author is of the opinion that the activity of the carbon is closely associated with the molecular complexity of the carbon. The greater the complexity of the carbon molecule the less the force available for sorption.[2] The sorbing surface would also be correspondingly reduced. . . . . . It would follow that in a comparatively inactive carbon, the carbon molecule is highly complex, and that only a very limited number of carbon atoms exert any attractive force. Any methods, therefore, such as heating to a high temperature, which bring about increased activity, do so by simplifying the carbon molecule. The simpler the final carbon molecule the greater the activity. It must not be assumed that comparatively mild treatment, such as heating at 120° C. in a vacuum, is capable of so altering the nature of the carbon. The apparent increase in activity in such cases is due to more complete elimination of materials already sorbed, such as water vapour, the last traces of which are held very tenaciously by the carbon. It has been shown that a highly reactive carbon gradually loses its activity. In this case the process is the converse of activation. The forces gradually focus round centres tending to form groups of the simpler molecules. The forces available for sorption are therefore correspondingly reduced. Ultimately, these simpler molecules, under the influence of these forces, coalesce, giving rise to more complex molecules with a corresponding loss of activity. The final repolymerization takes a considerable time, at ordinary temperatures, in the case of a mechanically rigid phase such as exists in amorphous carbon. The polymerization will be repeated, forming more complex molecules still, and will cease when the attractive force has been reduced to a value incapable of bringing about further union. When this condition is reached, *i.e.*, a highly complex carbon molecule, the sorptive activity is relatively very small. . . . . . ."

J. P. O.

[1] This analysis shows no non-sugar constituents, though probably the amount would be small.

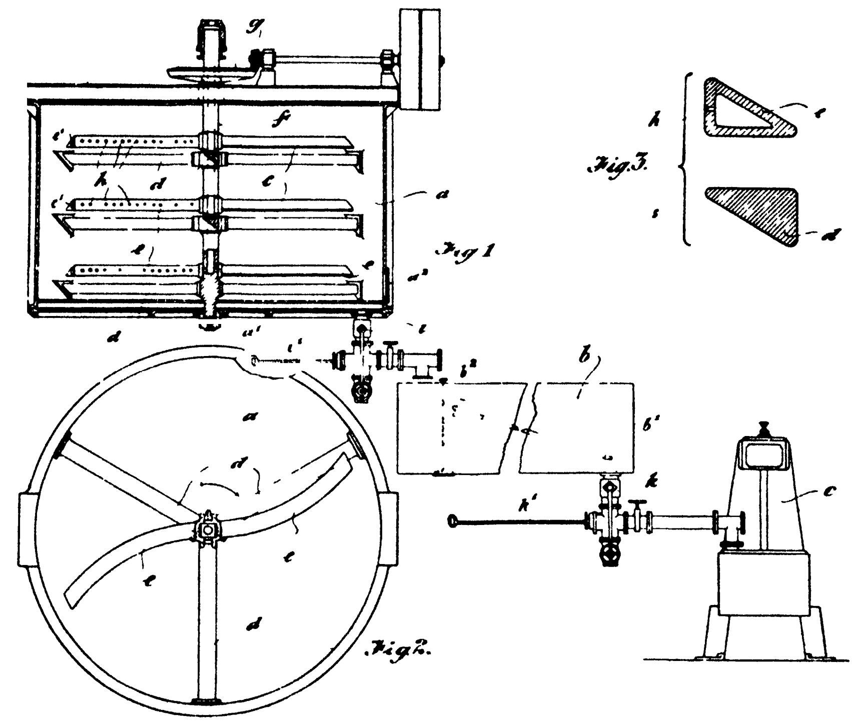
[2] "Sorption" is here used as a general term without differentiation between adsorption (surface condensation) and absorption (diffusion into the interior or solid solution).

Review of Recent Patents.[1]

UNITED KINGDOM.

Melting Pan, Settling Tank, etc., for Use in the Treatment of Gur, Jaggery, or Raw Sugar. *William Hulme and David A. Blair (of Blair, Campbell & McLean, Ltd.,* of Govan, Glasgow, Scotland). *195,780.* January 12th, 1923.

Gur, jaggery, or other raw sugar is melted by the combined action of heat and stirring devices, and the resulting liquor is allowed to subside, being subsequently purified by means of a centrifugal straining apparatus, or the equivalent. In the drawings are illustrated a preferred form of construction for carrying the invention into effect, in which *a* is the melting pan, *b* the settling tank, and *c* a centrifugal straining device. The pan is provided with alternate sets of fixed and rotatably mounted arms, *d* and *e* respectively, each set of the latter being located above a fixed set of arms so as to operate in conjunction therewith. Said rotatably mounted blades *e* are perforated and hollow as clearly shown in Fig. 3 and communicate with the interior of a central vertical hollow spindle *f* on which



they are mounted. This spindle is provided with gearing *g* to rotate same and at its upper end is adapted to be connected to a steam supply or hot air pipe. Both the rotating and fixed arms are of triangular cross section, the apexes of the former pointing in the direction of the motion and those of the latter in the reverse direction as shown clearly in Fig. 3. The perforations, indicated by the numeral *h*, are in the vertical sides of the arms opposite their leading edges or their said apexes. The foot of the said pan is provided with a false perforated bottom a^1, and a run-off cock *i* communicating with the shallow settling tank *b* of any suitable construction fitted with cover. Said tank is also provided

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

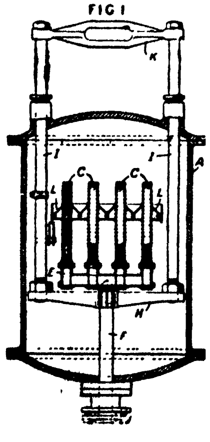
with a decanting syphon or like device b^1 common in cane juice subsiders, a plug or the like b^2, and a run-off cock k communicating with the centrifugal straining device c, having a strainer of cloth or any other suitable material. In operation, the lumps of gur, jaggery, or raw sugar are fed to the melting pan a, the rotatably mounted arms c set in motion and a heating fluid, preferably steam, though hot air may be used, supplied to the interior of the vertical spindle from which it passes to the hollow arms e, and then through the perforations h in the arms to the interior of the pan. By the combined action of the steam or other heating fluid, and the rotating arms, the lumps are reduced to liquid state; the liquor is then ejected by means of the run-off cock i to the settling tank b, the larger impurities being retained on the false perforated bottom a^1, and subsequently removed through the door a^2 in the side of the pan. The heavier impurities of the liquor in the tank b accumulate therein, and are discharged as desired by the operation of the plug or the like b^2. The liquor is discharged from the tank by means of the float syphon or like device b^1 to the centrifugal straining device c, and forced through the straining cloth or the like, which retains the impurities remaining. Then the sugar juice or liquor is further treated in the usual manner adopted in sugar factories. The said run-off cocks i and k may be provided with hand controlled plungers i^1 and k^1, by the operation of which the duct or passage leading to the settling tank or centrifugal straining device may be readily cleared if allowed to become choked. The perforated arms may be curved, the leading edges being on the convex side and the perforation on the concave side, as shown. To facilitate their cleaning they may be provided with removable caps e^1 at their outer extremities. According to a modification the arms d instead of being stationary may be made to rotate in the opposite direction to the perforated rotating arms. If desired the settling tank may be omitted and the liquor from the pan discharged directly to the centrifugal straining device.

INDICATING THE LEVEL OF LIQUIDS IN TANKS. *R. Boizard*, of Paris. *195,953.* March 21st, 1923; convention date, April 6th, 1922.

An electric lamp inserted in a wall of a water or other liquid container has its contacts so connected and arranged that a circuit is completed through the lamp when the liquid rises to the level of the contacts. In an illustration, lamps are shown inserted at various levels in a boiler gauge tube.

CONTINUOUSLY OPERATING FILTER. *Thermal Industrial and Chemical (T.I.C.) Research Co., Ltd., and J. S. Morgan*, of Grosvenor Gardens, London, S.W. *195,738.* January 4th, 1922.

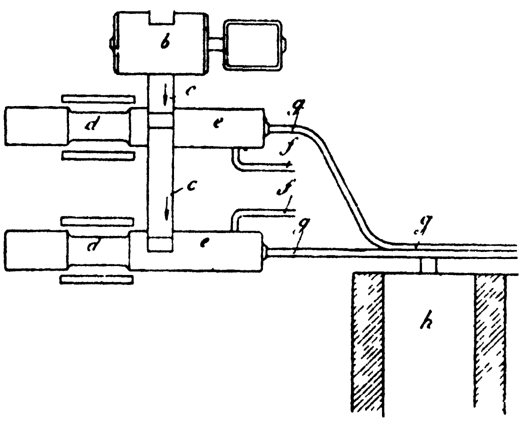
FIG I



Filter elements C, comprising corrugated or like plates covered with cloth, are connected by a hollow header E and pipe F to suction and pressure means. Header E is secured to a crossbar H connected by guide-bars I to an upper bar K, by means of which the elements C can be raised or lowered in the casing A. Filtration takes place under suction while the elements are immersed in mud or other material under treatment in the lower part of the casing. When cakes have formed, the elements are raised into the upper part of the casing which contains air, steam, or heated vapour under pressure. Suction is continued to draw in this vapour which thus dries the cake. Pipe F is then connected to a source of pressure, and gas or vapour is forced outward to loosen the cakes. As the filter elements are lowered solid matter is detached therefrom by pivoted scrapers I, which normally lie horizontal to form a tray on which the detached matter collects. Further downward movement of the guides I causes the tray to tilt, and thus discharge the collected matter into a hopper at the side.

EXTRACTION OF JUICE FROM THE CANE BY SHREDDING, MACERATING, AND PRESSING. *William Geveke*, of Munich, Bavaria, Germany. *196,224*. September 1st, 1922. (One figure; one claim.)

According to this invention, all the drawbacks incidental to milling, e.g., the production of a bagasse containing about 45 per cent. of water, and the considerable consumption of power by the gearing, are totally obviated. Cane is first subjected to a preliminary crushing or shredding operation, by which a part of the juice is extracted. It is not advisable to subject the cane to the action of saw-teeth or the like, as has been proposed heretofore, by which the fibres are torn to pieces. In crushers or shredders the fibres are simply exposed but remain intact. After shredding, the material is subjected to a spray of warm water or moist steam (by which it imbibes moisture), and is fed by means of carriers into plunger presses, which bring the material under such a high pressure, that, not only is the juice extracted therefrom, but a bagasse containing not more than 25 per cent. of water, making an excellent fuel, is produced. In the accompanying drawing, a figure showing a plan view of a device suitable for carrying out the method is reproduced. Cane is fed by a carrier *a*, into a crushing or shredding apparatus *b*, so as to be adequately divided. This material, after being sufficiently imbibed, is fed by means of a carrier *c*, into plunger presses *d* placed below said carrier *c*. In the pressing spaces *e* of said plunger presses the material is subjected to such a high pressure, say 10,000 lbs., per sq. in., that the juice is expressed and escapes through conduits *f*, whilst at the same time, the percentage of water of the remaining bagasse, which leaves the presses by the gutters *g*, is reduced to 25 per cent. or less. The bagasse leaving the presses can be conducted directly along the gutters to the boilers *h* where it is burned. By this invention, it is possible to extract the juice from the cane in a more economical and efficient manner than heretofore, since there is less consumption of power for the necessary driving machines. At the same time the material can be kept under a much higher pressure for a much longer time than is possible with the usual process of milling. For practical reasons the pressure which can be applied on the cane by the usual roller mills cannot exceed 3500 lbs. per sq. in., the duration of this pressure being no more than 15 secs. for a complete installation comprising a crusher and three or four mills. With the new method, the pressure of 10,000 lbs. per sq. in. can be exerted for a much longer time; but one minute is sufficient to obtain the desired low percentage of water in the remaining bagasse. The pressure is therefore about double, and the duration of the pressure about four times that of a modern cane milling plant, the consumption of power being reduced to about one half. The cost of the machines required is less than one half that of a mill plant of equal capacity. The presses for carrying out the new method can be directly driven by steam, or otherwise, so

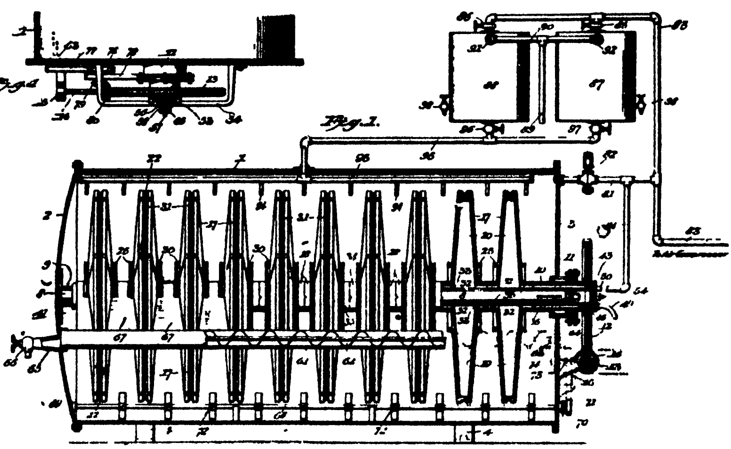


that the costly, energy-wasting, gear transmissions, inevitable in every mill plant, are avoided. Bagasse with 25 per cent. of water or less will not only be a valuable fuel for the factory furnaces, but also for locomotives and the like, so that this invention effects a solution of the fuel problem, which in sugar factories, is a constantly increasing trouble.

UNITED STATES.

Continuously-operating Air-pressure Filter. *John W. Brown*, of Denver, Colorado, U.S.A. *1,446,448*. February 27th, 1923. (Ten figures; five claims.)

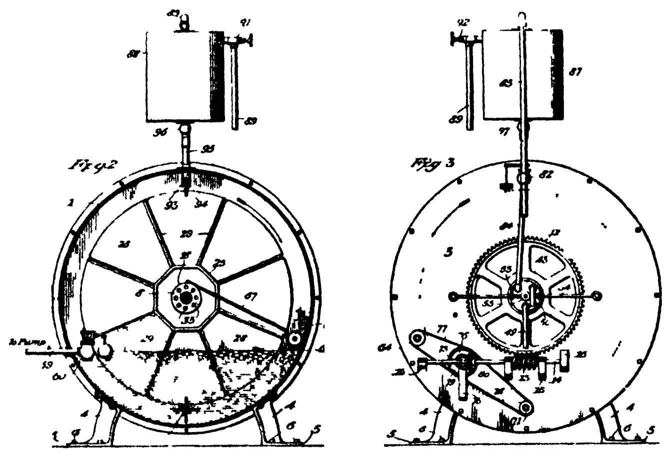
This invention relates to a new method and apparatus for an automatically and continuously-operating, direct air-pressure filter for filtering the first carbonatation juice in the manufacture of beet sugar, and also for other liquids. In operation, a mixture of juice and precipitate is pumped into the tank *1*, until the desired depth is reached, when the supply is automatically cut off by the float valve *60*. Air under pressure is then admitted to the tank through the pipe *81*, the pressure-regulating valve *82* being arranged to maintain a pressure in the tank of about 40 lbs. to the sq. in. Power is then applied to the driving shaft *14*, and the worm pinion *13* thereon causes the worm gear *12* to rotate slowly, together with the shaft *8*, and the filters mounted thereon. The air pressure on the liquid in the tank forces the same through the filtering material of the submerged portions of the filters. By reference to Fig. 2, it will be seen that there are always three



compartments of each filter which are wholly or partially submerged. After passing through the filtering material on each side of the filters, the filtering juice is forced up into the pockets *32*, and out through the lowermost passages *33*, of the filter hubs, and through the corresponding passages in the extension *10*, to the chamber *44*, of valve *43*, and thence out through the discharge pipe 49. As the juice is forced through the filters, the precipitate is deposited on the outside of the filter-cloth in the form of lime-cake, which contains a small percentage of sugar. This sugar is removed by spraying the cakes with wash-water, as the filters revolve, the wash-water being directed against the sides of compartments of the several filters by the nozzles *94*, as the said compartments reach the highest point in their rotation. This wash-water passes through the cake and filter-cloth to the uppermost pocket *32*, whence it is forced out through the communicating passage *33*, in the hubs, and is discharged through a pipe *50*, in the valve *43*. The chamber *45*, in the valve, allows the wash-water from each line of compartments to discharge during two-eighths of the rotary travel of the filters, and the chamber *44*, in the said valve permits the filtered juice to discharge from each line of compartments during three-eighths of the

rotary travel of the filters, or during the arc travelled by each line of compartments from their entering the juice until they emerge therefrom, as will be understood by reference to Fig. 2. As each passage *33* connecting a line of compartments registers with the port *51* in the valve *43*, compressed air, under a greater pressure than that maintained in the tank, passes through the said passage from the pipe *84* into the compartments communicating with said passage, and out through the filter-cloth, dislodging the lime-cake, this dropping upon the scrapers *67*, which also remove any cake adhering to the filter-cloth, as the filter revolves. The cake slides off the scrapers into the trough *61*, and is removed therefrom by the screw conveyor *62*, which forces it out through the discharge nozzle *65*. The valve *66* in this nozzle is adjusted to retard the discharge of cake sufficiently to insure that the outlet from the tank will at all times be kept closed by the discharging cake, thus preventing the escape of air from the tank with the consequent lowering of the pressure therein. It will thus be seen that the juice in the tank is filtered, the cake deposited upon the filter-cloth is washed, and the cake is dislodged from the filter-cloth, in the order named, and that during the process the juice in the tank is continuously agitated by the agitators *72*, as previously described.

Claim 3 of this invention reads as follows: "In a filter of the character described the combination with a tank, of a shaft rotatably mounted therein, a plurality of hubbed filter



units on said shaft, each having radial, non-communicating compartments and passages through the hubs connecting the aligned compartments in the several units, a hub extension on the shaft, extending through one end of said tank and having passages registering with those in the hub, a projection on one face of each hub, engaging a notch on the adjoining face of the adjoining hub, for holding said units in alignment, a reduced threaded end portion of said shaft, which extends through a wall in said hub extension and a jam nut on said threaded portion which is screwed against said wall, whereby the hubs of the units are held in engagement, a stationary valve in said hub extension, having two outlet ports and an inlet port, which register successively with said hub extension passages, means for admitting air under pressure to said tank and for maintaining a predetermined air pressure therein, whereby liquid in said tank is forced through the successively submerged filter compartments and out through one of the outlet valve ports, means for spraying wash water on the compartments after they emerge from the liquid in the tank, said water passing out through the other outlet valve port, said inlet port being connected with a source of air under greater pressure than that in the tank whereby such air is admitted successively to the compartments after the wash water treatment, to dislodge precipitate deposited thereon, and means for continuously removing said precipitate from the tank."

METHOD FOR EMPLOYING DECOLORIZING CARBONS AND OTHER ADSORBING MATERIALS BY CONTROLLING THE HYDROGEN ION CONCENTRATION. *Joseph F. Brewster and William G. Raines, Jr.* (Assignors to the Government and People of the United States of America). *1,447,461.* March 6th, 1923. (No drawings; one claim)

Colloidal impurities and colouring matters occurring in cane or beet juice, syrup, molasses, and the like, are coagulated, precipitated, or otherwise rendered more thoroughly adsorbed upon decolorizing carbons, kieselguhr and other adsorbent material by adjustment of the hydrogen or hydroxyl ion concentration to an optimum for the particular liquid to be treated. The novelty of the invention consists in adding acid or alkali as the case requires to the liquid until the hydrogen or hydroxyl ion concentration (or in other words, the particular acidity or alkalinity) has been reached at which the impurities and colouring matters are most readily removed by the adsorbent. The optimum reaction is readily found by experiment, the well-known colorimetric or electrometric methods being used, which optimum in the case of cane and beet products is about pH = 4 (Sorensen's scale). A much greater decolorizing effect with decolorizing carbon, kieselguhr, and other adsorbents is obtained at pH 4 than at pH 5; and much greater at pH 6 than at pH 7 (neutrality) or at pH 8 (slight alkalinity). But at this acidity in order to avoid loss of sucrose by inversion both time and temperature must be controlled, and the procedure recommended is as follows : The liquid is acidified to about pH = 4 with an acid such as phosphoric or an acid reacting substance as calcium acid phosphate; treated with the decolorizing carbon ; heated while stirring to the desired temperature (80 to 100°C.) for a sufficient time to permit adsorption of colloidal impurities and colouring matters to occur; and then partially neutralized by adding alkali until the hydrogen ion concentration has been reduced to about pH = 6 or 6·5. Actually what the inventors claim is: A method for employing decolorizing carbons and other adsorbing materials in a more efficient manner, consisting in adding to the liquid to be purified and decolorized by treatment with an adsorbing material, a sufficient quantity of acid to increase the acidity of said liquid to a hydrogen ion concentration of about pH = 4, in treating such acidified liquid with adsorbing material, and subsequently neutralizing the acidity of said liquid by adding alkali.

GERMANY.

APPLICATION OF DECOLORIZING CARBON FOR THE PURIFICATION OF SUGAR PRODUCTS, ESPECIALLY THICK-JUICES. *Curt Görlitz and Lehmaun & Voss*, of Hamburg. *363,699.* May 1st, 1921, published November 13th, 1922.

Hitherto (this specification explains) in the purification of sugar juices by means of decolorizing carbon, a rather considerable amount of this somewhat costly preparation has been found necessary, and even when revivification is applied the cost of its use is an important item. It has now been discovered, however, that one can operate with an astonishingly small amount of decolorizing carbon, if, departing from the usual procedure, it is allowed to act in conjunction with certain other clarifying materials, and the whole mixture treated with lime. In this way an expectedly great amount of colouring matter is carried down, and rendered capable of being filtered off, a particularly pure and brilliant juice thus being obtained. For example, in the case of thick-juice (evaporator syrup) to every cubic metre at 50-60° Brix 2-3 litres of milk-of-lime (more, if necessary), a similar volume of a mixture of kieselguhr and wood meal (in the proportion of 1 : 2), and only 300-500 grms. of decolorizing carbon, are added. After mixing the syrup with these materials, it is treated at a temperature of 90°C. with CO_2 or SO_2 until its alkalinity is reduced to 0·01-0 02, heated to 100°C., and passed through presses. Good cakes are thus obtained, which may subsequently be added to the juice, at the first carbonatation, or to the juice undergoing liming, the decolorizing power of the carbon being thus entirely exhausted, and the necessity of sweetening of the cake in the presses being avoided. Well adapted to this purpose is the decolorizing carbon known in commerce under the mark "L & V," which has a silicious structure, or bone charcoal may be used.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending June 30th,		Six Months ending June 30th,	
	1922. Tons	1923. Tons.	1922. Tons	1923 Tons.
Unrefined Sugars				
Poland	....	874	...	7,554
Germany	....	....	...	1
Netherlands	. ..	14		14
Belgium	....	....		...
France	....	...	..	....
Czecho-Slovakia		....	..	....
Java	..	4,882	1	17,431
Philippine Islands	....	....	..	....
Cuba	69,322	46,240	502,450	223,731
Dutch Guiana	560	471	2,355	2,395
Hayti and San Domingo	....	....	....	....
Mexico	.	. ..	....	....
Peru	9,072	2,127	44,508	51,286
Brazil	11,703	13,198	41,239	66,082
Mauritius	28,219	5,645	92,036	129,483
British India	....	2,558	....	10,862
Straits Settlements	....	..	....	....
British West Indies, British Guiana & British Honduras	23,303	23,462	66,497	75,324
Other Countries	3,200	6,530	32,614	52,081
Total Raw Sugars	**145,380**	**106,002**	**781,700**	**636,244**
Refined Sugars.				
Germany	...	....	....	....
Netherlands	1,143	4,417	12,455	28,033
Belgium	193	832	2,598	10,072
France	....	..	20	240
Czecho-Slovakia	1,209	7,666	24,454	67,818
Java	....	550	1	3,514
United States of America	43,596	34,401	169,796	90,860
Canada	17,265	13,710	41,752	24,802
Other Countries	302	1,819	4,973	22,774
Total Refined Sugars	**63,707**	**63,395**	**256,049**	**248,114**
Molasses	13,001	7,119	53,204	77,994
Total Imports	**222,088**	**176,516**	**990,953**	**962,352**

EXPORTS.

	Tons	Tons.	Tons	Tons.
British Refined Sugars.				
Denmark	235	78	861	523
Netherlands	304	91	1,778	839
Portugal, Azores and Madeira	....	...	....	....
Channel Islands	121	20	556	541
Canada	....	...	....	....
Other Countries	8,652	4,227	16,148	16,680
	9,316	4,416	19,343	18,584
Foreign & Colonial Sugars.				
Refined and Candy	383	907	1,248	2,682
Unrefined	4,258	23	6,595	10,270
Various Mixed in Bond	....	....	....	....
Molasses	1	190	899	1,932
Total Exports	**13,958**	**5,536**	**28,085**	**33,468**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922. Tons.
Total Receipts, January 1st to June 27th	1,835,351	..	2,229,310
Deliveries " "	1,828,816	..	2,157,024
Meltings by Refiners " "	1,662,560	..	2,033,163
Exports of Refined " "	160,000	..	403,000
Importers' Stocks, June 27th	6,535	..	72,286
Total Stocks, June 27th	173,310	..	199,752
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1920 21. Tons.		1921-22. Tons		1922-23 Tons.
Exports	1,313,434	..	1,875,214	..	2,357,833
Stocks	1,322,313	..	1,022,255	..	669,543
	2,635,747		2,897,469		3,027,376
Local Consumption	53,000	..	62,500	..	52,500
Receipts at Port to May 31st	2,688,747		2,959,969		3,079,876

Havana, May 31st, 1923. J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR SIX MONTHS ENDING JUNE 30TH, 1921, 1922, AND 1923.

IMPORTS.	1921. Tons.	1922. Tons.	1923 Tons.
Refined	203,211	256,049	248,114
Raw	496,354	781,700	636,244
Molasses	38,889	53,204	77,994
	738,454	1,090,953	962,352

EXPORTS	1921. Tons.	1922. Tons.	1923. Tons.
Refined	159	1,248	2,682
Raw	1,304	6,595	10,270
Molasses	345	899	1,932
	1,808	8,742	14,884

HOME CONSUMPTION.

	1921. Tons.		1922. Tons.		1923. Tons.
Refined	192,476		232,866	..	198,227
Refined (in Bond) in the United Kingdom	463,464	..	467,184	..	463,223
Raw	62,227	.	84,853	..	71,159
Total of Sugar	658,167		784,903		732,609
Molasses	5,819	..	4,229	.	5,311
Molasses, manufactured (in Bond) in United Kingdom	23,588	..	26,479	..	28,873
	687,574		815,611		766,793

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT JUNE 30TH, 1921, 1922, AND 1923.

	1921. Tons.		1922. Tons.		1923. Tons.
Refined in Bond	14,050	..	43,900	..	59,450
Foreign Refined	38,050	..	33,250	..	71,750
.. Unrefined	350,100	..	283,450	..	249,650
	402,200		360,600		380,850

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 296. AUGUST, 1923. Vol. XXV.

Notes and Comments.

The Market Situation.

The sugar market situation in America which governs very largely that in this country has remained decidedly confusing during the last month. The invisible supplies in the hands of the retailers and the public have continued at a minimum and buying has been restricted to actual immediate wants. What is more, there are fears expressed lest this policy should continue till the end of the year. The U.S. consumption for the first six months of the year, according to WILLETT & GRAY, is only 2·56 per cent. below that in the corresponding period of 1922, so it is evident that there is nothing wrong with the American consumption in general. Nevertheless, the hand to mouth policy it is now pursuing tends to keep prices at a lower level than the actual world's supplies would seem to warrant; the latest news is that Java, Peruvian, and Brazilian supplies have been offered on the New York market and have tended to glut it for the moment. One factor that has prolonged the stagnation of buying is that the American fruit crop is several weeks late this year, but as it is said to be a bumper one, the demand for sugar for its preservation is not likely to be less than usual.

WILLETT & GRAY estimate the American consumption for the first six months of the year at 2,603,591 long tons, as compared with 2,671,953 tons in 1922. The consumption during the second half of the year being as a rule slightly less than that of the first half, they assume their country will need about 2,400,000 tons from July 1st to December 31st; this would make the 1923 consumption about 5 per cent. less than that of 1922, whereas the yearly average increase during the past 100 years has been 5·4 per cent. They conclude that there is only just about this amount of sugar available without drawing on sugars that pay full duty. Incidentally, the statistics of the first six months reveal in one respect a marked difference as compared with the previous year. The Atlantic and Gulf refiners have had about 500,000 tons less of export business.

In the United Kingdom the figures for the same six months show that 732,609 tons of sugar was consumed, as compared with 784,903 tons in 1922 and 658,167 tons in 1921. This decrease is not surprising when we consider the high price of sugar (in part due to the duty), the still large proportion of unemployment in the country, and the cold weather we experienced throughout the months

of May and June. Unless there is an increase during the second half of the year, this amount would suggest an annual consumption of 1,500,000 tons for 1923, as compared with about 1,600,000 tons in 1922. The fruit crops are below the average, so that this source of consumption is not likely to augment the demand for sugar.

New Beet Sugar Ventures in England.

Thanks to the remission of the Excise duty on sugar, the financial aspect of the establishment of beet sugar factories in this country has undergone a decided improvement; according to Mr. G. H. Roberts, M.P., there is now in existence a group of financiers ready and willing to put up the whole of the money for the erection and equipment of a series of factories throughout the country. What remains to be done is to interest the farmers sufficiently to induce them to guarantee supplies of beet. The fact that the beet crop of 1922 was about the only profitable one grown by East Anglian farmers last year will have a powerful influence in converting growers in other parts of the country to devote a part of their acreage to sugar beets.

There has been a revival of propaganda work amongst the farmers the last few months and one gathers that the meetings of farmers to discuss the question have been much more optimistic than was the case a few years back. Plans for new factories are taking shape once more. There is a project in Suffolk (already referred to by us[1]) which is likely to go through before long; South Lincolnshire farmers are pressing for a factory in the Spalding area, where a heavy tonnage of roots is grown and the sugar content is high; at Kidderminster, where so far back as 1911 an effort to start a factory failed owing to lack of financial report, fresh endeavours are being made and a scheme involving a capital outlay of £500,000 for building and equipping a factory has been approved by a meeting of those interested; the agriculturists of Wiltshire, Somerset, Hampshire and Dorset were lately invited to a meeting at Salisbury to discuss the erection of a central beet sugar factory to serve the interests of the growers of these four adjoining counties, when Mr. G. H. Roberts, M.P., an expert Norfolk agriculturist, himself interested in beets, addressed the gathering and gave a detailed account of the prospects of beet sugar production in this country. All these gatherings of farmers indicate that a changed attitude towards sugar beet cultivation is coming over the country, and if it is true that the necessary capital (at least £400,000 per factory) can be obtained, there seems little doubt that in a few years the number of factories in England will be considerably greater than the existing *two* which are like oases in the desert.

The Future of Kenya.

Kenya Colony, as British East Africa has come to be known since the Great War, has lately been agitated by a dispute arising out of the presence in that country of three races, the Whites, the British Indians, and the indigenous Natives; the precise mode of administration has been at issue, and an appeal to the Home Government has lately had the careful attention of the Cabinet and the Colonial Office. There was a demand for self-government on the part of the whites which was echoed on their part by the Indian immigrants, and neither of these parties, it would appear, proposed to consider seriously the claims of the natives as the original inhabitants.

The Home Government has decided that Crown Colony Government is the only satisfactory method, for the time being at any rate, of holding the scales

[1] *I.S.J.*, 1923, 232.

evenly between the contending parties, and it proposes to continue the system. It naturally declines to consider the claims of the Indians, who are mostly low caste, that they should be admitted to equal status with the British settler. On the other hand, the claim of the whites for a special close restriction on Indian immigration is refused.

The Government's decision includes the following points: A form of communal franchise is to be established, and the Legislative Council is to consist of eleven elected white representatives, five elected Indian unofficial members, and one elected Arab member. Segregation in townships as between Europeans and Asiatics is to be abandoned. The existing practice of virtually reserving the Highlands for European settlement is to be maintained; an area is to be reserved in the Lowlands experimentally for agricultural development by Indians. Racial discrimination in immigration is not to be countenanced.

The Government Memorandum on the subject points out that the question of the status of Indians in Kenya became a matter of Imperial policy with the recent change in the consitutional and political position of British India; the Kenya crisis arose from the conflicting interests in the ownership of land in the Highlands, where alone the whites can thrive. The decision of the Government protects the whites, but at the same time disallows restrictions on Indian immigration and expansion in other tracts of the colony. As regards the natives, it is laid down that as Kenya is an African territory their interests "must be paramount; and that if, and when, those interests and the interests of the immigrant races should conflict, the former should prevail."

We mention in some detail this decision of Colonial Government because the territory affected is one where a cane sugar industry has a likely future before it, while other territories in British Africa indicated as available for sugar production are probably also equally affected. The Government's attitude in the present case is an indication, if not a firm precedent, as to the mode of administration in all cases in Africa and elsewhere where race conflicts arise. The decision is also important in that it establishes a new status for the British Indian immigrant; while quite rightly not admitted to equal elective rights with white settlers, he is no longer to be debarred by special immigration laws from settling in any of the parts of the Empire controlled by the Colonial Office.

As regards Indian immigration into other Crown Colonies, the Indian Government embargo on such proceedings which has been more or less in force for some years, is tending to be raised. That Government has now consented to let Indians emigrate once more to Mauritius, terms having been arranged with the Mauritius Government which are considered satisfactory to the unskilled Indian labour concerned. This encourages the hope that the further colonization of British Guiana by Indians will shortly be achieved; we understand that negotiations for the resumption of emigration from India to that South American colony are about to be resumed, and having regard to the fact that an arrangement has been come to with Mauritius, it is reasonable to suppose that the door will be similarly opened to British Guiana, where Indians enjoy the fullest civil and political liberty. It seems probable that any resumption of this immigration will be on the colonization basis.

Indian Sugar Companies.

A special article in *Commerce* (Calcutta) dealing with the four properties of Messrs. Begg, Sutherland & Co., in India, states that they one and all show indications of able management. Prospects for sugar companies in India

generally must now be regarded as favourable; prices throughout the world have risen, and the Indian import duty now in force protects Indian producers to a degree previously unthought of, according to our contemporary. Stocks of sugar in India have been substantially reduced, so that all sugar factories in the country that can obtain a sufficiency of cane should do extremely well this season if properly managed.

Of the four factories above referred to, the Ryam Sugar Co. is now ten years old. Its capital consists of 400,000 rupees in ordinary shares and 300,000 rupees in debentures; but the latter are now being all paid off. For the year ended June 30th, 1922, the profit was very substantial, being 71½ per cent. of the ordinary capital; of this 40 per cent. was distributed to the shareholders. The Cawnpore sugar works is the oldest of the Begg Sutherland group, having been registered in 1894 with a subscribed capital of 100,000 rupees in ordinary shares, and 500,000 rupees in preference shares. The factory is capable of producing about 8000 tons of sugar and a million gallons of alcohol annually. Since 1917 the dividends have been 35, 25, 40, 60, 25, and 40 per cent. respectively, which averages about 41 per cent. for the six years. The Champaran Sugar Company, situated at Chakia in Bihar, was registered in 1905. During recent years a system has been inaugurated there under which the Company now pays the cane growers on a co-operative basis. Results have thoroughly justified this system and the quantity of cane treated has greatly increased, last year constituting a record. For the year ending June, 1922, the Company made a profit of 50 per cent. on their capital. The fourth concern of this group is the Samastipur Central, a new factory which had its origin in the purchase of the plant of the liquidated Ceylon Sugar Refineries. This Samastipur Central Sugar Company was registered in 1919 with a subscribed capital of 1,200,000 rupees, and although it is only two years since the removal of the plant was completed, the last balance sheet showed the net profit to be slightly under 15 per cent. of the capital.

Viewed from the standpoint of West Indian outputs, these are but small factories; but the profitableness of their business is on a scale that would in most regions have led to a very rapid expansion. That it has not done so in India can only be ascribed to the difficulties inherent in the native ownership of land and the conservatism of the native farmer who has to be educated to understand the benefits arising from a more rational form of cultivation than he has hitherto practised. The system of co-operative farming tried by the Champaran Sugar Company is in principle on the right lines, and we are glad to see that the results have been satisfactory. Finally, the protective duties should enhance still further the profitable nature of a well-conducted Indian sugar industry, and may lead to the flotation in the near future of other companies, providing the difficulties inseparable from the agricultural side can be overcome. With the improved outlook now offered both financially and botanically (as witness the recent inauguration of improved seedling canes) the prospects of the Indian sugar industry seem brighter than they have been for a long while past.

The Rise of Czecho-Slovakia.

Since the War, the most prominent European country amongst those manufacturing sugar has undoubtedly been Czecho-Slovakia; the fact that her people's interests were all on the side of the Allies in the great conflict facilitated her access to independence once the power of the Austrian Empire was crushed.

In a recent Department of Overseas Trade Report on that country there appears a foreword appraising the present position of the country and indicating some of

the difficulties that face her people in their endeavours to establish their new Republic on a firm foundation. "Czecho-Slovakia (this Report remarks) is the one new country created by the war about which so much has been written and published that it is impossible to avoid repetition. A continuous and intensive propaganda campaign has been conducted through the inspiration of those to whom the prosperity of the Republic is of vital importance, and nothing good or interesting about it has been omitted. The main features are its central European geographical situation, its inheritance of 80 per cent. of the industries of the late Austro-Hungarian Empire, its steadfastness to a financial policy diametrically opposed to that of its neighbours, namely deflation, its continued favourable annual trade balance, and its leading international economic position amongst Central European countries.

"On the other hand, although Czecho-Slovakia since it came into being as an Independent State has enjoyed this pre-eminent stability and its prospects appear good, it is too soon to form any opinion as to the future, which is dependent on so many internal and external factors of unknown value. New industries are cropping up in all the Succcession States whose natural desire for economic independence is taking increasingly practical form, and whilst it is now realized by the Czechs themselves that a Customs Union (Zollverein) for all the Succession States is the only remedy for a rebirth of their industrial prosperity, the before-mentioned fact is creating the ever-increasing barrier to the realization of this common policy. The industrial inheritance of the Republic is already proving so unwieldy that for some time past it has been an accepted fact that a very substantial reduction must take place in the manufacturing industries, certain branches of which must become extinct altogether, to the benefit, it is hoped, of the agricultural industry, where considerable room for development exists. The division of labour in the Republic shows 40 per cent. engaged in agriculture, 38 per cent. in industry, 10 per cent. in commerce and transport, and 12 per cent. as clerks, professionals and military, so that as at present constituted it is evident that prosperity depends upon ability to sell manufactured and other products in foreign markets. This ability, unfortunately, is severely restricted.

"Czecho-Slovakia is one of the highest taxed Continental countries, and this, coupled with high wages and the proportionately high foreign value of the Czech crown has cut off foreign markets. Whilst it is obvious that Czecho-Slovakia with a normal surplus of manufactured goods cannot be a natural market for similar British products, she, however, does present a good market for raw materials, metals, cotton, wool, etc., which she must import. The bulk of these are supplied by her neighbour, Germany, and the United States of America is a favoured competitor. The average annual proportion of combined import and export trade between Great Britain and Czecho-Slovakia is about 6 per cent. of the total, but there is reason to believe that when the Commercial Treaty now being negotiated between the respective Governments is completed our trade will increase. Czecho-Slovakia's chief customers, however, will always be her neighbours, viz., Germany, Austria, Hungary, etc., and the important factor not to be lost sight of is Russia, which in due course may open up enormous possibilities for the marketing of Czecho-Slovakian products."

An Essay in Capital Levy.

While on the subject of Czecho-Slovakia, it is worth referring to the fact, mentioned in the same report, that this country was the first State which attempted to place its finances on a sound basis after the chaotic conditions prevailing after the war by introducing a Capital Levy. This tax was levied on all

property (movable and immovable) situated on Czecho-Slovak territory and on all foreign securities in the possession of Czecho-Slovak subjects. But the results are now reported to have been extremely disappointing and the measure itself has been a source of considerable embarrassment to the Government. The law is most complicated and has not been carried out to the letter. Demands for payment have been made to those known or believed to be in a position to pay, but the actual sum to be paid has in most cases been the subject of negotiation and in almost every case the final assessment has been far below that fixed by law. Apart from that, the levy has had a very detrimental effect upon industry and commerce, but owing to the slow and lenient manner in which the law has been applied, it has not had the disastrous results which it otherwise would have had if it had been strictly enforced. As it is, it is highly probable that a very large proportion of the tax levied will never be paid.

Dr. C. A. Browne, Chief of the Bureau of Chemistry.

Since 1921 the important position of Chief of the Bureau of Chemistry of the Department of Agriculture, Washington, an appointment held for some time by Dr. W. H. Wiley, and latterly by Dr. C. L. Alsberg, has been under the direction of an acting head. It is now announced that Dr. C. A. Browne, Chemist to the New York Sugar Trade Laboratory of New York, recognized as a foremost authority on matters concerning the chemistry of sugar and its manufacture, has accepted the post.

Dr. Browne, whose high capabilities are well known to readers of this *Journal*, was born in 1870 at North Adams, Mass. He studied sugar chemistry in Germany under Tollens; and from 1902 to 1905 he was research chemist at the Experiment Station of the Louisiana State University, and later was assistant to Dr. Wiley at the Bureau, the chief executive of which he has now been appointed. Since 1907 he has been Chemist to the New York Sugar Trade Laboratory, during which period he wrote his "Handbook of Sugar Analysis," a work that is recognized as the standard publication of its kind; and in addition contributed a good number of valuable papers dealing principally with matters concerning sugar. He is Chairman of the New York branch of the American Chemical Society, and it may be added that he took a leading part in the organization of the successful sugar section of the American Chemical Society. In the important position of Chief of the Bureau of Chemistry, Dr. Browne will have full scope for his conspicuous abilities, and his success in this larger sphere will be anticipated by his many friends of the sugar industry.

Peru's Handicap.

Those who have observed from time to time the extremely lucrative nature of the sugar industry in Peru may sometimes have wondered why the total production of so large a country was not much greater. The explanation of course lies in the fact that save for the narrow strip of country bordering the sea coast, the vast bulk of the area of Peru lies to the east of the mighty Andes mountain range and is devoid of easy communication to the sea on the west, while to the east the Brazilian forests form an impenetrable barrier for transport. Hence the large and fertile tablelands of Montana which are peculiarly suited to grow sugar, tobacco, coffee, cocoa and other tropical products are incapable of development till the problem of transporting those products cheaply and expeditiously to the sea coast has been solved.

A recent number of the *Financial News* gave some interesting details of the prospects of this region of Peru. According to it, the Montana is capable of

accommodating millions of settlers. It contains some 325,000 square miles of irrigated land, in addition to vast areas which do not require this aid to production. Some eight hundred miles in length from the Maranan to the Bolivian frontier, it is watered by numerous big rivers and streams, and must possess a soil enriched by the alluvial accumulations of uncountable ages, a soil whose power of fructification must be virtually inexhaustible. Yet it is practically as neglected by the world to-day as it was when Cristoval de Acuna drew the attention of Spain to its overflowing riches.

Our contemporary points out the striking contrast between this land of enchanting beauty and perfect climate, a land of hill and dale, and that centre of the the continent, some hundreds of miles further east, which is the unexplored haunt of savage mystery and impenetrability. The one is absolutely fitted for the settler, the other is still an unknown and doubtful quantity. In the Montana besides tropical products, there are gold mines waiting to be worked, and oil is said to be abundant, but unexploited. The one thing lacking is communication, and until capital provides the means of building railways to open up this virgin country, its development will be deferred. But once the railways run through the Andes, there would be a rush of settlers, and a vast new area of agricultural and industrial wealth would be opened up to the lasting benefit of Peru.

The British Industries Fair (a now annual event organized by the Department of Overseas Trade) will be held next year from April 28th to May 9th at the White City, London, W.12. This is a later date in the year than has hitherto been customary, but is rendered advisable from the fact that the British Empire Exhibition will then be about to open and the number of visitors to this country will be correspondingly greater. The Fair and the Exhibition do not clash, as the former is confined to British manufactures and is open only to trade buyers, while the latter is open to the public and is representative of the whole Empire.

The *Times Trade Supplement* reports that the Governor of British Guiana, after a conference with the Executive Council, the elected members of the Combined Court, and the British Guiana Sugar Planters' Association, has approved a scheme by which the Colonial Government would acquire a privately owned sugar factory and plantation, which the owners proposed to dismantle, for £25,000, the Government to run the estate as a cane-farming experiment for three years and a half, during which time all who desire to do so should be given opportunities to take up land and acquire the factory. If at the end of three and a half years the cane-farming scheme is not a success, or does not warrant continuation, the factory should be dismantled and the lands sold as soon as possible. The scheme is to be referred to the Secretary of State for the Colonies for his approval.

The *British Australian* states that under the new plans of the Australian Government, it is hoped to reduce the retail price of sugar by ½d. per lb. to 4½d. per lb., to reduce the price of sugar to manufacturers by £5 per ton, and to supply sugar for export from Australian stocks at the actual world's parity in such a manner that manufacturers will not be at a disadvantage by not having freedom to import. Under the new scheme a voluntary sugar pool is to be formed, and up to June 30th, 1925, there will be an absolute embargo on the importation of sugar grown by black labour except that which is required to make good any shortage occasioned by partial failure of the Australian crop. For the 1223-24 season the maximum price of raw sugar paid will be £27, f.o.b. at the mills. The pool will arrange with the refineries to refine and distribute sugar at a price approved by the Commonwealth Government, and must provide sugar to be used by the manufacturers at a price equal to the current world's parity. A tribunal will determine the price for raw sugar, basing it upon the cost of efficient production in reasonably good districts, but, as before-mentioned, it must not exceed £27 per ton. After June 30th, 1925, when the embargo on imports ceases, there will be a protective import duty on sugar of such an amount as may be required to permit the industry to carry on at a reasonable profit, when black-grown sugar is at a normal price.

Fifty Years Ago.

From the "Sugar Cane," August, 1873.

With this number of the *Sugar Cane* the fifth year of its existence was entered, and the Editor thanked subscribers and advertizers for the support heretofore accorded in attaining a comparatively large circulation, and appealed for hearty co-operation for its continued success. He pointed out that "to many among the most thoughtful and discerning whose capital or talents are embarked in sugar production, the present seems a time when it is indispensable that the cane should possess as valuable a literature as the beet; and it is for those who unite in these enlightened views to further the interests of the cane by heartily supporting this, the first serious attempt to establish such a standard literature." In explaining the *raison d'être* of the publication, he remarked that this was to present "an invaluable record of the many phases through which the industry has passed, and an index of the intellectual activity of the men who are making a minute study of the chemical economy of sugar manufacture," and further to put "the chemistry of the agriculture of the cane on a secure foundation. . . . . ."

One of the articles appearing in this issue was entitled "Concerning Sugar Deterioration," and was written by Dr. E. A. Cook. This chemist was unable to offer any definite explanation of the cause accounting for the many cases of the alteration of various grades of raw sugar which during his experience he has observed. He believed, however, that a species of ferment, known technically as "smear," and the variation of the temperature, were two of the main factors, and he finally remarked that "whether the deterioration of sugar after manufacture and during transit is due to any one or all of the above causes may be a matter of opinion, but it is a fact that dry sugars are admitted not to deteriorate. . . . ."

At a meeting of the Chamber of Agriculture, Basse-Terre, Guadeloupe, a paper was read on the use of carbolic acid for the prevention of the cane borer, an extract stating that "by plunging the heads of the canes before planting them into a solution containing 1 per cent. of phenic acid, the production of the borer and other insects is prevented. . . . . The heads of the sugar canes after having been immersed for 12 hours in the phenic solution become more vigorous, are entirely free from insects, and are a month in advance of the plants which have not been immersed. . . . ." A plate was reproduced showing a so-called Belouguet cane perforated in many parts by the borer, which at that time was causing considerable anxiety in Mauritius.

An article was published by Alfred Fryer, the Editor of the *Sugar Cane*, on the effect of sulphurous acid on solutions of sugar ; and judging from the remarks here made it is evident that this reagent was at that day employed in an extremely unscientific manner. It was used in considerable excess, and the loss due to inversion must have been a very high one. Mr. Fryer remarked that "the planter may improve the tint of his muscovado sugar, but he will learn in time that nearly the whole of his sulphur bloom will have passed away when his samples become exposed for sale in Mincing Lane. . . . ." ; and that moreover "many refiners are averse from purchasing sugars that have been made with bisulphite of lime, owing to the conversion of the carbonate of lime into sulphate of lime. . . ."

The coming American beet crop is preliminarily estimated by Willett & Gray at 750,000 long tons, harvested from 727,528 acres, as compared with 541,113 acres and 615,936 tons in 1922. The U.S. Department of Agriculture estimate places the acreage at 732,000 with a possible outturn of sugar of 728,500 tons.

The Irrigation of the Sugar Cane in Hawaii.

Irrigation in the sugar cane fields in the Hawaiian Islands is not confined to those parts on the western side where the rainfall is insufficient for the growth of the cane to maturity, but extends throughout the planted area, especially in Kauai, Oahu and Maui. Although the local practice of irrigation has turned out to be a very costly proceeding when compared with that in other parts of the world, it is found to be a very paying proposition, and the plantations are not only concerned with the tapping of rivers and the storage of the rainfall and bringing these supplies on to their fields, but this supply is supplemented by immense pumping plants by which the underground water supplies are brought to the surface and similarly utilized. And so convinced are the planters of the profitableness of this line of development that, besides the investment of large sums of money in canals and pumps, the labour allocated to the leading of the water on to the fields has become the dominant item in the balance sheet of those estates which use this means of increasing their outturn of sugar. In addition to all this, they are spending large sums of money on reafforestation, in order to keep up the supplies of soil water and to utilize to the best advantage the natural rainfall of these favoured islands.

A full study of the whole subject has been made by W. P. ALEXANDER and is presented in a thesis "in partial fulfilment of the requirements for the degree of Master of Science in the University of Hawaii," and this has now been published by the Hawaiian Sugar Planters' Association in pamphlet form.[1] This pamphlet deals with the whole accumulated literature of the subject (73 papers) and is compressed into 109 pages, with 63 illustrations and numerous tables. As the author has himself done much useful research on the subject and leaves no part of the field untouched, the paper is an extremely valuable one. It is well and clearly written, although in parts the desire for compression has made it a little difficult to follow, and one would in some places have wished for a more generous treatment as regards explanatory remarks.

The thesis commences with a brief introduction of a general and historical character (10 pages), and this is followed by a detailed review of irrigation practices, continuing with summaries of the various lines of research which have been followed by the different workers in the field from the commencement, and concluding with a detailed local bibliography of the subject. To give an idea of the treatment and the relative development of the different sections, these are given below with the number of pages in brackets devoted to each: After the introduction follows a brief statement of the standard method of Distribution of water in the field (2), and an important discussion of the Application of water, including the most recent variations from this method (33). Then the following are dealt with in briefer summaries: Duty of water (5), Conservation of water (13), Soil moisture studies (6), Economical distribution and optimum application (9), Time element in irrigation practice (7), Saline irrigation (2), and Application of fertilizer in irrigation water (2). Owing to the great mass of material brought together, it is somewhat difficult to review the paper, but the present article endeavours to lay out before our readers the salient features of this great problem, and this is to a certain extent rendered more easy by the recent publication in this Journal[2] of a description of the more recent advances in economizing the labour involved.

For the production of profitable crops of sugar cane, over 50 per cent. of the fields in the Hawaiian Islands are almost entirely dependent on irrigation, and

[1] "The Irrigation of Sugar Cane in Hawaii." W. P. ALEXANDER. Experiment Station of the Hawaiian Sugar Planters' Association. Honolulu, 1923.
[2] *I.S.J.*, 1923, 180-184.

the tonnage from this proportion of the area under cane exceeds two-thirds of the total sugar output. This will be readily understood from the subjoined figures of the irrigated and unirrigated areas under cane in the four sugar cane growing islands. In Kauai 40,036 acres are devoted to sugar cane cultivation, 95·66 per cent. of which are irrigated: the figures for Oahu are 40,352 and 98·25, and for Maui 50,906 and 89·52; while, on the other hand, there are 93,126 acres of cane land in Hawaii, only 6·97 per cent. of which are dependent on artificial watering.

Irrigation has been used in the local sugar industry from its start. The first project was carried out in Maui in 1878, when water was diverted from the rainy eastern slopes seventeen miles across to the arid western side: this was completed at a cost of $80,000. It was immediately followed by a large project carried out by the Hawaiian Commercial and Sugar Company for the irrigation of the central Maui plains, and from this beginning an irrigation system has developed which has cost some $4,000,000, the latest addition being the great Wailoa ditch delivering 140 millions of gallons at an elevation of 1100 ft. and costing $1,500,000; this aqueduct the author regards as the largest in the world. An enumeration follows of the chief projects for the storage and delivery of rainfall water on similar lines throughout the islands, mountains being tunnelled, valleys bridged and syphons erected for the negotiating of the irregularities of the mountainous country to be traversed. Besides these projects, steps have been taken to tap underground water supplies which would otherwise be wasted, and a number of immense pumping stations have been installed, the machinery alone of which has cost some $6,000,000. The electrification of the latter has recently been undertaken as it has been proved to be by far the most economical method of lifting the water. Altogether, the 24 plantations on which irrigation is employed have invested something like $17,000,000, while close on 100,000 acres of forest land are owned and set apart for the conservation of the water supplies.

It is estimated that in Oahu 2500 millions of gallons of water are pumped every month from artesian sources for the sugar plantations. For the maintenance of this supply, assuming that there are 300 days in the year used for pumping, it is necessary for 25,000 millions of gallons to enter the underground system every year. The proportion of watershed is considered to be twice that of the cane area served, and thus 100 inches of rainfall a year must find its way from the forests into the subsoil. The conservation and replanting of the remnant of the natural forests of the islands, which have been deplorably devastated for many years past, has thus become a matter of supreme importance to the planters, and is, in fact, receiving marked attention from the Hawaiian Sugar Planters' Association, which is working hand in hand with the Government and the individual planters themselves.

The cost of irrigation per acre and per ton of sugar is set forth for the crop of 1914 in a table, in which the averages work out as follows: cost per acre $67·91, per ton cane $1·42, percentage of labour employed on irrigation to total labour in getting the crop to the mill 62·97. These figures are then compared with those obtained from Porto Rico and Cuba, although irrigation in the latter island is to be regarded as in a purely experimental stage. In 18 Porto Rican plantations the cost of irrigation per acre is given as $15·76 and that per ton of cane $0·63, while the figures for the four Cuban estates are $2·18 and $0·08 respectively. From these details it is obvious that in Hawaii the profitable production of sugar is subordinated to the intelligent use of irrigation. With this idea in his mind, the author of the thesis aims at a stimulation of research in this direction and devotes his attention chiefly to the means by which the heavy costs of applying the water to the fields may be reduced to a minimum.

The standard irrigation practice in Hawaii is concisely described by means of a diagram here reproduced (Fig. 1). The elements thereof, once the water has been brought to the plantation, consist of a series of water channels of different calibre and arrangement. These are, in succession, as follows: main supply ditches, running along the higher contour lines and therefore more or less level; straight ditches more or less at right angles to them, that is, running down the slope; level ditches again running along the contour lines and 200-300 ft. apart; watercourses, small improvised channels down the slope leading the water to the furrows, the latter lying more or less across the slope of the land, 30 to 35 ft. long and about 5 ft. apart. The adaptability of this scheme to all kinds of topography has made its practice almost universal. But, as will be seen, there are numerous small deviations according to the conditions.

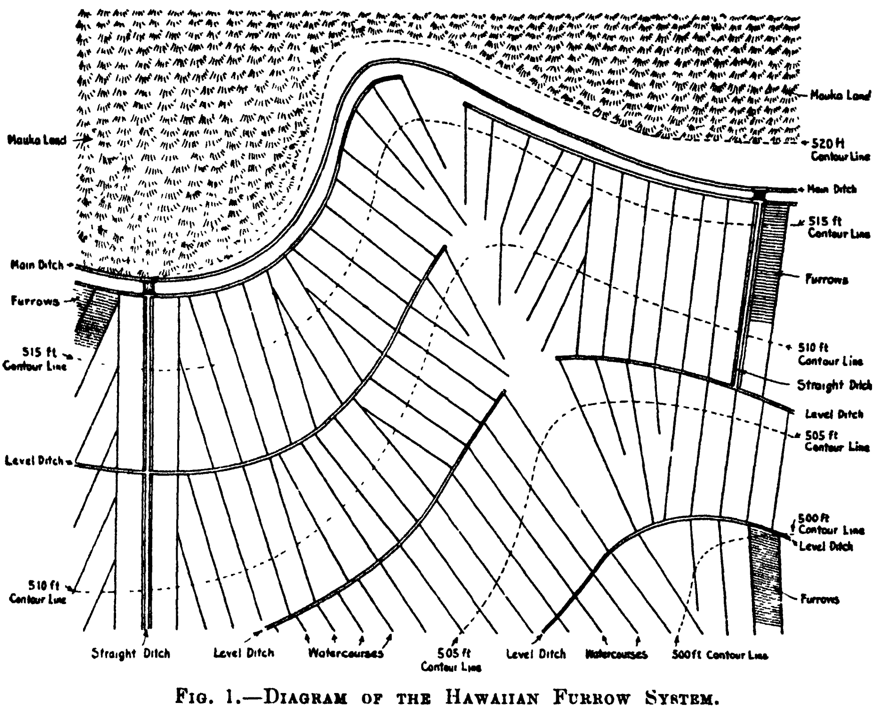


Fig. 1.—Diagram of the Hawaiian Furrow System.

The method of supplying the water does not greatly vary, but the actual practice depends on a great number of special local circumstances. Such are the nature of the supply, whether steady or fluctuating, and its sufficiency for maintaining the supply all the year round; the occurrence of freshets with only a limited water storage capacity; whether the cost of pumping as supplemental is found to be profitable; the necessity of over-irrigation because of salinity; the labour available and its skill and the nature of the supervision required; the texture of the soil, whether light or heavy, rocky or smooth; the presence of coral below, retention of moisture and drainage facility; the condition of the field, whether the furrows are shallow or deep, and the condition of the watercourses; the slope and regularity of the contour; the kind of cane grown, its habit, whether erect or recumbent, light or heavy yielding, the amount of trash produced, whether plant

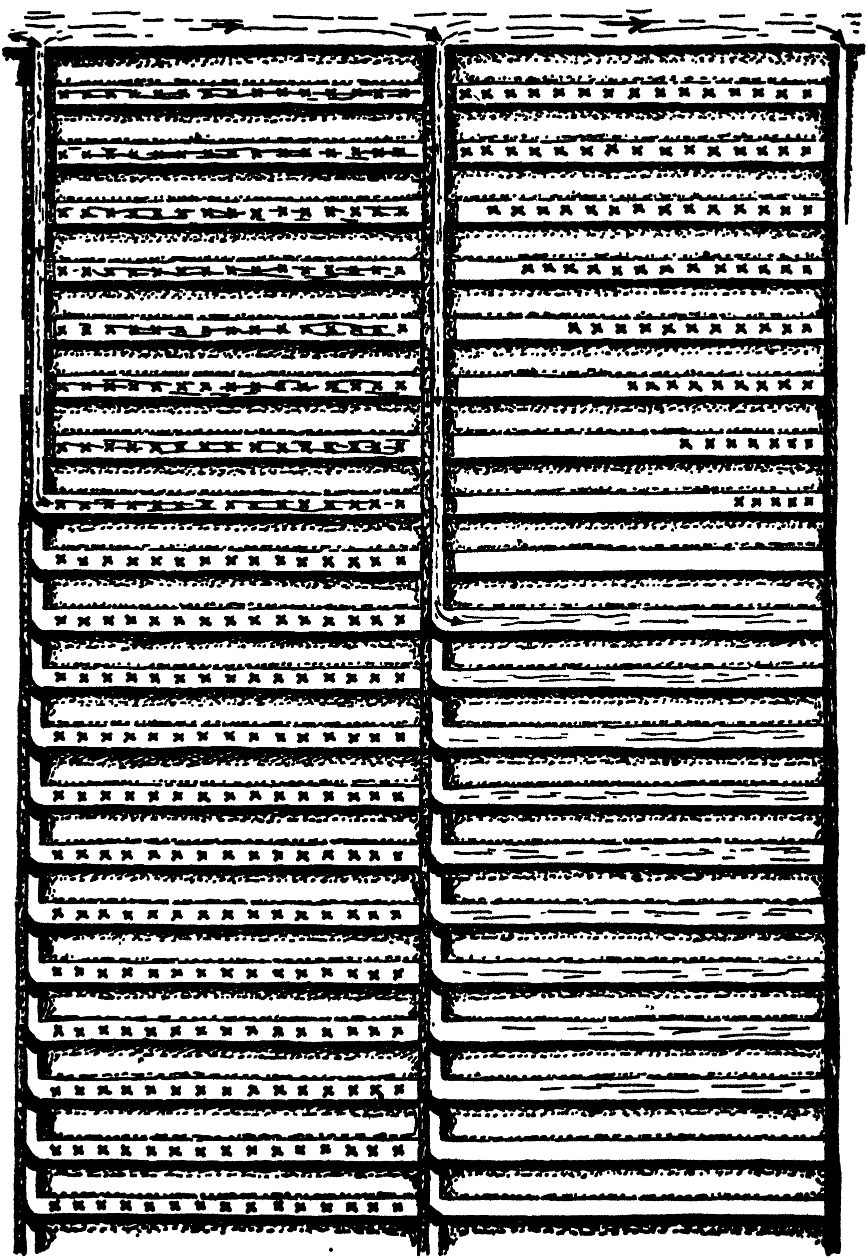


FIG. 2.—HAWAIIAN FURROW SYSTEM.

An enlarged sketch of the actual layout from level ditch to furrow, showing the arrangement of watercouses and furrows when each row of 35 ft. is irrigated separately. There are between 40 and 70 furrows to one watercourse, depending on the field and plantation practice. The crosses signify the position of the cane plants in the furrows.

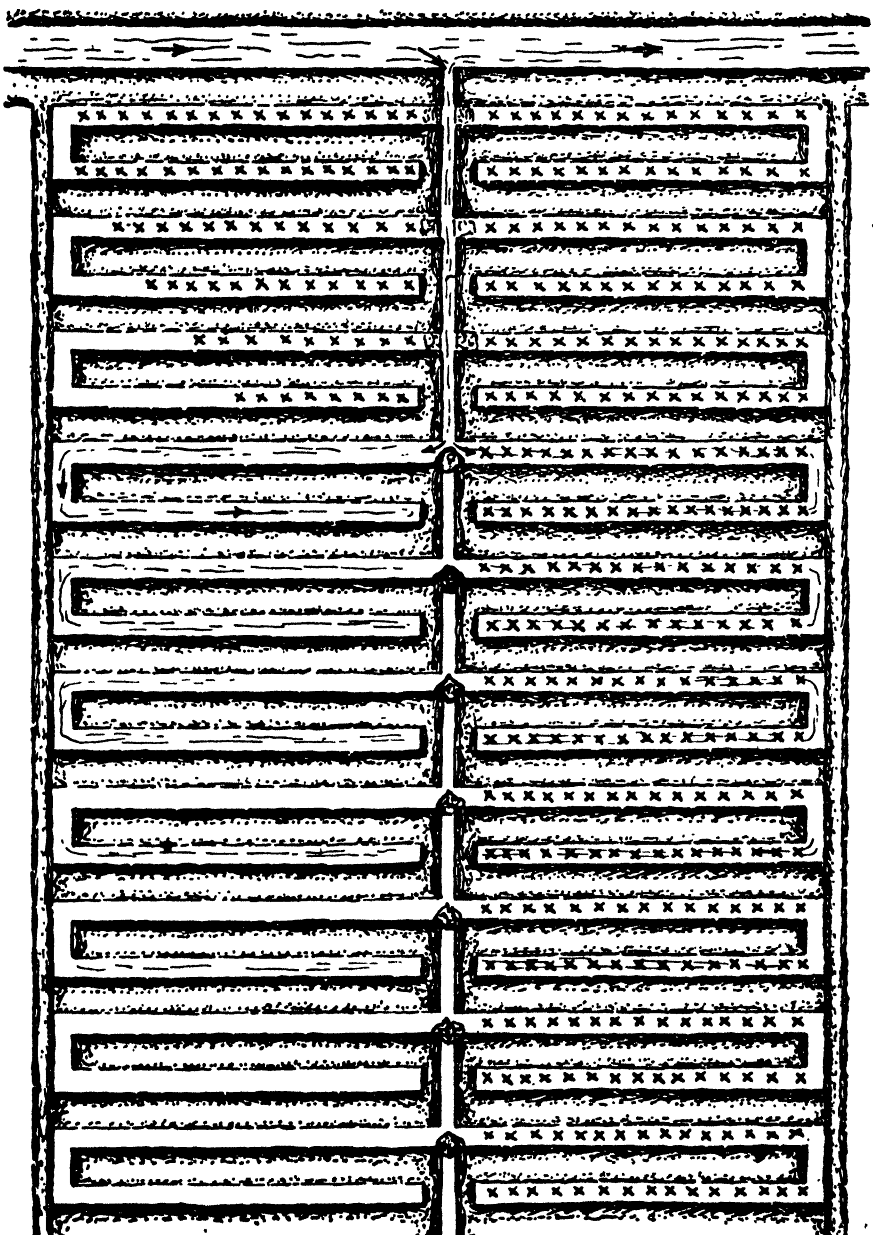


FIG. 3.—EWA OR RENTON SYSTEM.

This system which is a combination of cutting one line and the two-way system is practised on the 7500 acres of Ewa Plantation with great success, also in the Waimea region of Kauai. The watercourses are about 70 feet apart, which is one-half the number in the standard Hawaiian furrow system. Lines are cut so that the water runs to form a U. The irrigator standing on the watercourse can thus see when to change his pani Water is

cane or ratoons, hilled or unhilled; the periods of irrigation and the relation of these to weeds, the possibility of applying fertilizers in the irrigation water, and so forth.

In the standard practice every row is irrigated separately from one side only of a watercourse (Fig. 2), and this is considered the best method by the managers of the largest and most successful plantations. The two-way system as described by MAXWELL gives water to the furrows from both sides of a watercourse at the same time; it is said to be economical of water, but even land is required. Every other row irrigation is an emergency method for hilled-up cane, the alternate rows being filled up with trash; it saves time and weeding and is a big help when water is scarce. Percolation is found to be sufficient to keep the soil moist, but the ultimate yield of canes is deficient.

Cutting lines is the name given to another method, in which one outlet of the watercourse irrigates a number of furrows in succession, as follows: When the water reaches the end of the first furrow, the ridge between it and the next below is cut across, so that the water enters the latter and flows back again towards the watercourse, and by repeating the operation a number of furrows can be dealt with by one opening from the watercourse. In one form or another this deviation from the standard is used by 16 out of 26 plantations, but only after the first two or three months. It is useful for holding back the water of freshets with little natural storage capacity, or for flooding after a dry spell when heavy rains occur. The first furrow of course gets too much water and the method is inapplicable to porous soils. When the water is short, single line irrigation is reverted to.

The Ewa or Renton system (Fig. 3) is a combination of the two-way and cutting line systems and saves labour, as well as land because half the usual number of watercourses with their banks are available for cane growth. In 1914 by the old method one man was able to irrigate 8·29 acres in a day, but in 1916 by this system a single labourer was found to be able to attend to 13·35 acres. The system has been in use on the Ewa plantation for 20 years, but it is only practised on three plantations. The chief objection is that lands are usually too steep and that too much soil would be washed away, but it has much to recommend it in the saving of labour.

Grove farm standard system. Here there are three changes in the method during the growth of the crop; the watercourses are 50 ft. apart and the level ditches 300 to 400. Single furrow irrigation is practised for the first three to four months. Then three successive ridges are cut, so that each opening of the watercourse irrigates four furrows; the furrows are thus divided into blocks of four. When the canes are six to eight months old, that is in the spring, the blocks are enlarged, so that 20 to 30 furrows are served by one outlet from the watercourse, and one man can irrigate 5·6 acres in a day. The chief advantage is that the whole plantation can be irrigated in a few days, and this is especially useful where freshets with limited storage occur.

Flooding is not considered practicable as a rule because of the waste of water. It is only possible when the shortage of labour is acute, as was the case in the 1920 Oahu strike. These are the chief variations given of the standard practice of irrigation in the islands. But, with the field thus prepared, the increasing paucity of labour in 1921 induced various planters to think out new methods whose main aim was to save labour, sometimes at a certain cost of efficiency. Labour has become a limiting factor, and a number of novel and ingenious methods have been evolved which are classed together by the author under the heading New Methods. Of these the main idea is to make irrigation as far as possible

automatic, and in a recent number of this Journal[1] three methods classed under Kilauea Automatic Irrigation by the author have been described, namely, the Modified Orchard system, the Hillside or Huli-Huli system and Old Ratoons laid down to the standard system but converted to the automatic. The Baldwin Flume system, also automatic, was described at the same time. These systems are one and all of great ingenuity and significance, and the reader is referred to our reference to them for the details. There remain two other systems to complete the number described by the author.

No watercourse system, or simply furrows 200 ft. long between two adjacent level ditches. Renton devised the system and gave it over to the author to carry out. About 10 furrows can be irrigated at the same time, and the method is at present purely experimental; if the flow is found to be too rapid, it may be readily checked by the insertion of low dams along the furrows at the necessary intervals. The method has received careful study and a Table records soil moisture determinations at different distances along the furrows.

Waipio system. This is automatic and is being conducted under the auspices of the Hawaiian Sugar Planters' Association on their sub-station at Waipio. The level ditches are 20 furrows from one another and the furrows are 30 ft. long and must be level. To consolidate the soil and thus prevent washing, the first two or three irrigations are according to the standard method. Then the ridges are cut to 15 ft. lengths, these cuts alternating in successive ridges down the slope. The bottoms of all the cuts must be at the same level, and 3 ins. above the bottom of the furrow; the cuts are protected by a mulch of trash or better of paper laid over their lowest part to prevent washing. The whole system is made automatic by outlet boxes in the level ditch, and a gate is placed in the latter between each set of furrows served.

This part of the paper concludes with an experiment conducted by the author at Ewa, in which three systems were compared during nine months in 1921, in a uniform, level field of H 109 plant canes of very vigorous growth It was one year old at the start when it had approximately 50 tons of cane to the acre; at the time of the last irrigation the weight of cane was estimated as at least 95 tons to the acre. The methods compared were the Ewa system already described, semi-flooding, which was merely an adaptation of the latter whereby, instead of four furrows, 20 to 24 were irrigated at one time, and ordinary cutting of the lines and the resulting zigzag flow of water through the furrows. The latter gave a very slow movement of water, because of the small slope and heavy growth of canes, but no difficulty was experienced with it. The labour saved by the Ewa system was very satisfactory when compared with that of the standard practice, and labour was also saved by the zigzag method. Stripping of the canes, however, could only be done by the irrigator in the Ewa system, and the cost of this operation, which had to be done by an extra man owing to the lack of time, has to be added to the irrigation cost in the other two.

Duty of water. This is the water required to bring the crop to maturity and to obtain the optimum growth. A considerable number of papers have been issued on this subject, but unfortunately there is no uniformity in the standards used, and the canes were grown under very different conditions. The author thinks that, considering the importance of the subject, the information obtainable in Hawaii is very meagre. A summary history of the experiments is given, the results having been converted into comparable figures, and 16 of them have been tabulated. Where possible some of these have been averaged, but in the bulk of them this was not feasible. The following averages are extracted from the table:

[1] *I. S. J., ibid.*

1. Acre-ft. required to bring the crop to maturity, 19·13.
2. Gallons of water per acre to bring the crop to maturity (not so convenient for irrigators but universally adopted in the islands), 6,205,888.
3. Yield of sugar per acre, 6·66 tons.
4. Tons of water to one ton of sugar (although frequently used this is not a recognized standard), 3,898.
5. Tons of sugar from a million gallons of water (safe and more scientific), 1·091.
6. Gallons of water applied per acre per day (deduced from column 2, with 460 days' irrigation for crop), 13,941.
7. Acres covered by one million gallons of water in 24 hours (said to be 100 but the average in the table is) 75·15.

"Vorrett's tabulation of the amount of water used at Waipio for the crop of 1921 is 5·9 acre-ins. (presumably per irrigation), producing 9·85 tons of sugar, or 2140 tons of water per ton of sugar. The average interval between irrigations was 20 days, being longer in winter and shorter in summer."

ALLEN at Waipio experimented for 4½ years on the duty of water on short ratoon crops (12 months?) and obtained the following results:—

1. Average yield per acre of tons of cane, 36·91, of tons of sugar, 4·46.
2. Water used per acre, in gallons, 2,479,858, in acre-ft., 7·613.
3. Water used per ton of cane, 69,020 gallons, or 0·211 acre-ft.
4. Water used per ton of sugar, 582,870 gallons, or 1·789 acre-ft.
5. Lbs. of water used for 1 lb. of sugar, 2421.

(To be continued.)

Sugar in East Africa.[1]

In response to an enquiry by the British Empire Producers Organization the Department of Overseas Trade have now received a report from Colonel FRANKLIN, His Majesty's Trade Commissioner in East Africa, giving the result of his enquiries in the matter of the sugar industry in British East Africa.

He states that there is only one factory in the territories Tanganyika, Zanzibar and Uganda, namely, that which Messrs. Mathradas Nanji & Co. propose to erect at Jinja, Uganda. As regards producers in Uganda, there are a number of European and native planters who cultivate sugar cane, mostly on a small scale, the area under sugar being about 4,000 acres. Hitherto, there has been but little attempt at refining, the native growing the crop mainly for chewing or, in a few cases, for the production of "jaggree."

The factory in course of erection by Messrs. Mathradas Nanji & Co. will probably have the effect of extending the cultivation of sugar cane, as it is the intention of the firm to buy up native grown cane for crushing; they have also planted up some 1,400 acres of sugar cane and anticipate a production of 20 tons of white sugar per day. Sugar cane grows well throughout Uganda, and it is anticipated that in the course of a few years this country will be self-supporting and will also have sufficient for export to surrounding territories.

With regard to Kenya Colony, there are a considerable number of sugar cane growers in the territory (Colonel FRANKLIN suggests probably in the neighbourhood of 100 of which some 90 are Indians) all of whom produce cane for stock feeding purposes or jaggree for the local or neighbouring markets. Hitherto, the only white sugar factory has been that of the Victoria-Nyanza Co., Ltd., at Miwani, Kenya Colony, but Messrs. Sukari, Ltd., are now erecting one near Nairobi. The estimated area in Kenya Colony under sugar cane is 3787 acres.

Colonel FRANKLIN, in conclusion, states that although at present there is only one white sugar factory in the whole area, the other two will shortly be established, and he is of opinion that when all three factories are in full working order, their capacity for production will be fully capable of supplying the market throughout those territories.

[1] From *Production and Export.*

An Improved Method of Liming in the Defecation, Sulphitation, or Carbonatation Method of Clarification.[1]

By D. J. W. KREULEN.

INTRODUCTION.

Let us consider first how the clarification of juice is carried out in factories in Java making white sugar. Measured juice runs through a strainer into a tank connected with a pump, which forces it through a set of pre-heaters, after which it enters the sulphiters. Above these sulphiters is an open tank for containing the milk-of-lime, having a run-off cock, and an adjustable over-flow. The capacity of this tank stands to that of the sulphiter in a certain relationship, which is capable of modification by the adjustable over-flow, and depends on the quantity of milk-of-lime it is desired to add. When one of the sulphiters is full, the workman opens first the SO_2 valve and then the discharge cock of the lime tank, so that the milk (say at 15°Bé.) runs into the juice. During the whole operation of sulphitation, the juice should show only a faint pink to phenol-phthalein, though in practice the observation of this rule leaves much to be desired.

In this method of working, however, even if the operator holds strictly to his directions, at the place where the milk-of-lime meets the juice, there is a large zone which is strongly alkaline. As the result of the alkalinity, gums are dissolved from the particles of bagasse, which always are present, no matter how carefully straining may have been performed. Further, a good deal of saccharetin passes into solution, which, when one is endeavouring to produce a white sugar, is an occurrence to be guarded against. Of course, the effect of saccharetin may be counteracted by the careful sulphitation of the syrup; but anyway prevention is better than cure, especially as this is a substance which, after it has once entered the juice, remains there, leaving the factory only in the molasses.

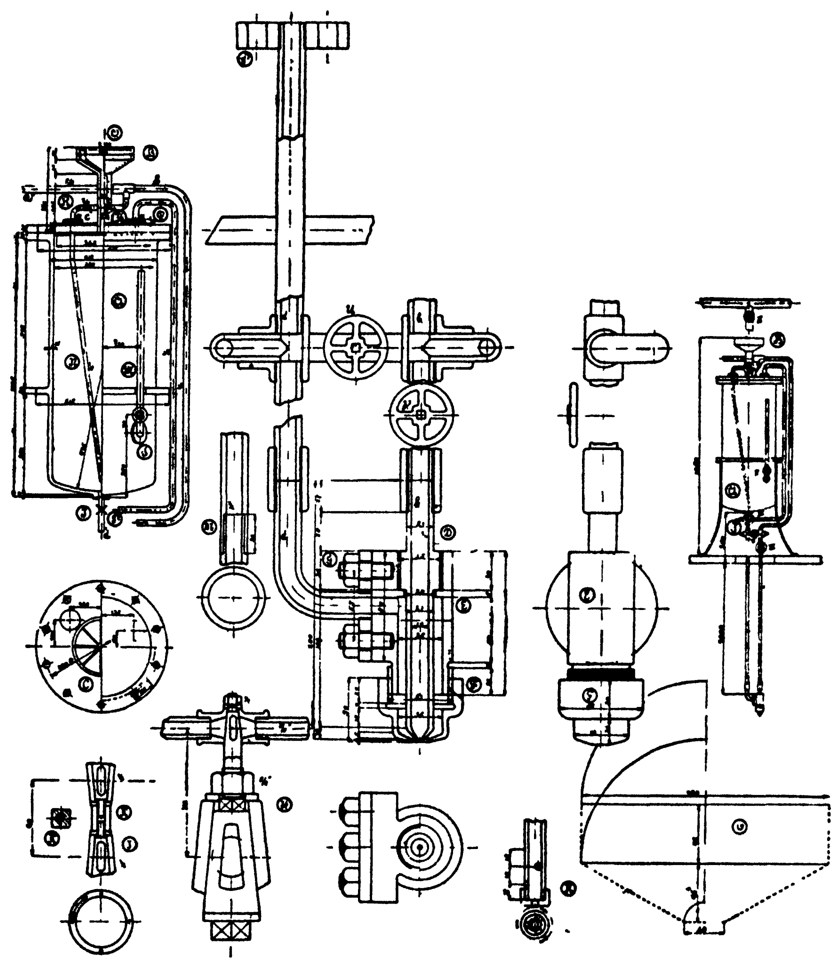
But the worst effect of the alkaline zone (which would appear to have a diameter of about one metre) is on the "glucose" of the juice. In sulphitation factories the coloured decomposition products are temporarily bleached by the reducing action of the SO_2-ion, whereas in carbonatation factories their formation is immediately seen by the increased colour of the juices. Another result of the alkaline zone is that the milk-of-lime is not brought into sufficiently intimate contact with the impurities, the concentration of which remains high, to the unfavourable appearance of the crystal.

DISTRIBUTION OF THE MILK THROUGH THE JUICE BY ATOMIZING.

These and other considerations have impelled the writer to discover a method of working, which in the first place shall considerably diminish the alkaline zone, and in the second shall effect an intimate admixture of the milk-of-lime and the raw juice. In order to realize these conditions, the distribution of the milk-of-lime must be effected through the juice by means of air through an atomizer, and the result of this should be: (*a*) a better distribution of the milk-of-lime through the liquid; (*b*) a lower local alkalinity, and therefore a lower glucose decomposition; (*c*) an improved adsorbing power of the crystal (of calcium sulphite or calcium carbonate), owing to the lower local alkalinity, and thus an improved mechanical purification.

[1] Abridged translation from *Chemisch Weekblad*, 1922, 19, No. 44, 458–461.

Apparatus to be used for blowing air through the juice during liming should be constructed as indicated in the sketches, the open liming tank of the present procedure being replaced by a closed vessel *A* (Fig. 1) into which the milk enters after passing a sieve placed in the funnel *B*, the proportion added being controlled by means of the over-flow pipe *M* placed above the shut-off cock.



Air necessary for the operation of the apparatus is tapped from the chest of the sulphur oven, and is brought along by a $\frac{5}{8}$ in. pipe *a*, which divides into the $\frac{3}{8}$ in. pipe *c* and the $\frac{1}{2}$ in. pipe *b*. This pipe *b* is carried round to the bottom of the liming tank, and continued to the atomizer (seen in the Fig. 2) placed in the sulphitation tank. Further, the pipe *QP* is provided, and also a shut-off valve *I*, the plug of which is on the same spindle as the shut-off valve of the milk-of-lime pipe *d*, so that when the milk-pipe is open the pipe *QP* is closed, and *vice versa*. A similar two-way valve is also arranged in the line connecting the funnel *B* with the vessel *A*; and by this means when the funnel is in open communication with

the vessel *A*; the air-line *c* is closed, and conversely. Again, there is a circulating pipe between the air-line *b* and the milk-of-lime pipe *d*, provided with a valve *U*, and a valve *V*, capable of arresting the entrance of air to the atomizer.

Method of operating the New Apparatus.

Assume now that the vessel *A* is empty, and that the position of the valves is as follows:—*V*, closed; *U*, open; pipe *d*, closed; and therefore *QP* open; overflow valve *S* open; pipe *c* closed; and thus the funnel *B* open to vessel *A*. Then we may allow carefully screened milk-of-lime to run into the vessel *A* by way of the funnel *B*, there being no resistance to so doing, since the vessel *A* is open to the atmosphere through the valve *QP*. As soon as pipe *M* begins to overflow, the valve *S* is closed, and afterwards also the valve in the neck of the funnel, whereat simultaneously air is blown through the pipe *c* and is evolved through some holes in the tube *N*, bubbling through the milk-of-lime, and later being led out through *QP*.

Now sulphitation may be commenced. Therefore first the SO_2 valve is opened, next valve *V* (whereat the air begins to blow through the atomizer), and then valve *I*. When these are opened, pipe *QP* is automatically closed; and, by means of the air-cushion that forms in the top of the vessel *A*, the milk-of-lime is forced through the pipe *d* into the atomizer. Since the quantity of milk-of-lime in the vessel *A* is always diminishing, more air must be introduced in order that mixing may be continued. A spring ensures that if the operator releases the handle of the valve *I*, the pipe *d* is immediately closed, and *PQ* is thus opened.

When all the milk-of-lime has been used, the pipe *d* and valve *V* are closed through the connecting pipe from *b* to *d*; thus, by opening the valve *U*, air may be blown into the milk-of-lime pipe in order to prevent the obstruction of the atomizer. Anyway, the atomizer can very easily be made so as to be easily disconnected. Its adjustible cone *F* ensures that exact regulation can easily be made.

[Referring to the figure on the right-hand side of the drawings here reproduced, showing the apparatus as a whole, the manipulation of the various valves are as follows: (1) all valves are closed; (2) *III* is opened, then *I*, then *II*; (3) when over-flowing takes place *II* is closed, then *I*, then *III*; (4) *VI* is opened, then *IV*, and sulphiting commenced; (5) then *VI* and *IV* are closed; (6) *V* is opened, after which the cycle of manipulations is repeated.]

Some modifications can always be applied in practice; but the principal matter is that the dispersion of the milk-of-lime with air and its better distribution through the juice is capable of causing a lower alkalinity, an improved purification, and a smaller number of by-reactions.

According to the *Times Trade Supplement*, the report of the Colonial Sugar Refining Company, Limited, for the half-year ended March 31st last shows a net profit of £251,394 19s. 4d. A dividend of 5 per cent. was paid and £50,000 was placed to reserve, leaving £38,894 14s. 4d. to be added to the balance at profit and loss which now amounts to £326,715 19s. 3d. The report states that though the weather has been favourable in Fiji, it is unlikely that the crop of 1923 will be more than one-third of the capacity of the mills. In the following year a larger supply of cane will be available, but there will be much lost ground to recover when the requisite labour can be obtained. In Queensland and New South Wales, the partial failure of the summer rain has reduced the expected outturn of sugar by one-fifth, though the crops promise well for next year. Sales of refined sugar during the half-year have been large; whether all delivered has gone into consumption is yet uncertain.

On the Cause of Sugar Dust Explosions.[1]

By GEORG JAECKEL and PAUL BEYERSDORFER.

EXPERIMENTS ON THERMAL DUST EXPLOSIONS.

Ignition by sparks.—In a previous paper by one of us,[2] unsuccessful experiments on the ignition of clouds of sugar dust by sparks were reported; but, according to a theoretical investigation by the other author,[3] no other result could hardly be expected. Nevertheless, further tests were instituted in order to attempt to ignite a jet of sugar dust by means of an emission of sparks from different kinds of iron and steel.

By preliminary experiments it was shown that a jet produced by blowing dust from a capillary, 1-2 mm. wide, could always easily be ignited by a burning match. So as to give the sparks opportunity to remain in contact as long as possible with the same dust particles, care was taken to cause these to fly in the same direction and as nearly as possible at the same rate as the particles of the ejected jet of dust. If, on the other hand, the rate of generation of the sparks along the path of the jet had been greater or slower than the rapidity of the particles of dust, a certain amount of heat would have been dispersed. Then the possibility of the sparks giving up sufficient heat to meet the following conditions would be small: to bring the sugar up to the melting temperature of 160° C.; to gasify it; to raise the decomposed gases to ignition point; and finally to ignite these gases.

In spite, however, of the arrangement of the experiments being extraordinarily favourable, the numerous attempts which were made failed to effect a positive result. This perhaps is not altogether unexpected, for a great amount of heat is required for the melting and gasifying of the dust; and in evidence of this one may reflect on the familiar examples of the calories necessary for the conversion of ice at 0° C. to water at the same temperature, or for transforming water at 100° C. into steam also at 100° C.

Ignition by hot bearings, etc.—It is recognized that the second great explosion which took place at the Frankenthal Refinery on May 16th, 1917, had its focus in the jaw crushers, serving for the preliminary disintegration of the sugar. Pieces of metal (escaping the magnets) might have entered these machines, and might as the result of the continuous concussion have reached a sufficiently high temperature to effect ignition. Certain of our experiments had as their object the examination of this point.

Pieces of iron and steel were placed in a jaw crusher, which was operated for a time. But in no single instance could any appreciable heating of the foreign metal be detected when it was felt with the hand immediately after stopping the machine (thus making it unnecessary to use the thermo-couple which had been installed for ascertaining any possible rise of temperature which might have taken place). This negative result may be explained by pointing out that the pieces of metal introduced into the jaw crusher came into intimate contact with a large mass of metal inside the machine, so that any heat formed was quickly dispersed.

Expression has been given by critics to the view that explosions may be caused by hot-running rollers of crushing mills. But with the relatively small number of revolutions of the rollers, and with the great thermal conductivity of the metal, it is hardly conceivable that they could be heated to the temperature of ignition. Each of the rollers weighs 300 kg., and the heat units necessary to raise two of them only 1°C. are: $2 \times 300{,}000 \times 0{\cdot}12 = 72{,}000$ grm. calories, or 72 kg. calories. Since, however, they must be heated to about 400°C. to make a

[1] *Vereinszeitschrift*, 1923, 136-157. This is an abstract, not a literal translation of the original article. [2] *I.S.J.*, 1922, 573-577. [3] *I.S.J.*, 1923, 363.

thermal explosion possible, $400 \times 72 = 28{,}800$ kg. calories must be supplied, which is equivalent to the energy in 4 kg. of coal.

EXPERIMENTS ON ELECTRICAL DUST EXPLOSIONS.

Electrical generation in mills.—As the result of the laboratory experiments in the previous paper by one of us,[1] the electrical charging of the dust particles in crushing mills having rollers is to be expected. During the operation of a machine of this type (which had smooth rollers 1 mm. apart) matters were so arranged that a stream of the ground sugar was caused to flow out, the vessel collecting it being connected with an electrometer. In this way the existence of considerable electric charges on the disintegrated sugar could be established; and had the rollers been set more closely together, so that grinding was more intense, greater charges must have been generated.

Electro-static measurements have to be carried out with special precautions, which cannot be realized in works' practice, and so the matter of the extent to which sugar dust may become charged was submitted to laboratory experiments.

Sugar dust was blown by means of a current of oxygen through a capillary tube into a hollow vessel, which was connected to an electrometer and in parallel to a glass-plate condenser of 200 cm. capacity. As the result of the friction in blowing only 3·7 mgrms. of sugar dust through the capillary tube, a voltage of 470 was read. This is equivalent to a charge per grm. of $8{\cdot}5 \times 10^4$ electro-static units, a figure corresponding closely to the value capable of effecting ignition of a cloud of sugar dust which was calculated by one of us.[2] This appears to be most striking evidence in favour of the cause of sugar dust explosions being due to electrical charging.

CAUSE OF EXPLOSIONS OCCURRING IN REFINERIES.

Improbability of thermal ignition.—Let us imagine how and where any appreciable amount of heat may be formed in the crushing department of refineries. Foreign substances (metallic and mineral) may enter the disintegrating machines, and may cause sparking. That their presence cannot give rise to any appreciable amount of heat has been proved experimentally; but there is the question whether the sparks to which they may give rise may be capable of igniting a cloud of dust. Theory replies to this in the negative,[3] and this is also the reply given by the experiments which have been made under extremely severe conditions (a piece of iron violently grinding against a rough emery stone) and with all possible variations, always without an ignition. Practice has thus confirmed theory; so that ignition by sparking appears altogether improbable, and indeed may be stated to be outside the range of possibility.

Bearings and rollers may run hot, the former more so than the latter, since their heat capacity is smaller, as one knows from experience. Bearings, however, are situated outside the disintegrating machines, so that they are not actually in contact with a dangerous concentration of dust, since rooms in which the mills are placed are never filled with an amount corresponding to 20 grm. per cub. metre, even under the worst conditions of working. In fact, a cloud of dust through which one can no longer see has at the most a concentration of only 0·5 grm. per cub. metre; so that, supposing a bearing were heated red-hot, it would not mean an immediate source of danger.

In the case of the two rollers of a grinding machine rubbing against one another, the heat formed is immediately dispersed towards the direction in which the temperature is lowest; and the great heat capacity of such rollers (weighing about 300 kg. each) can allow no appreciable rise of temperature. We therefore

[1] *I.S.J.*, 1922, 573–577. [2] *I.S.J.*, 1923, 367. [3] *I.S.J.*, 1923, 365.

arrive at the conclusion that the theory of an explosion in a refinery (which is not antiquated, and is run with reasonable care) being due to ignition by heat is entirely eliminated.

Probability of electrical ignition.—If mechanical or kinetic energy converted into heat cannot be the cause of dust explosions, then (so far as our present knowledge goes) there remains only the last form of energy to consider, that which is electrical.

Theory teaches that in the electrical production of an explosion there is neither a lower nor an upper limit of cloud concentration (as in the case of thermal explosions). It further informs us that the greater the concentration of dust, the smaller is the charge per grm. sufficing to effect spontaneous ignition. With very low dust concentrations, a very high charge per grm. is necessary, one that is very difficult to reach in practice. On the other hand, with very high dust concentrations (such as may very well occur in the disintegrating machines), the danger of explosion is very great immediately the crushing is commenced.

Experiments made in the factory have shown[1] that, even under the most unfavourable conditions, very considerable voltages (as much as 1700) may be generated in the crushing mills; while quantitative laboratory experiments (just described) have demonstrated that sugar dust may very well become so strongly charged by friction as to generate an amount of electricity capable of exploding a dust concentration of 157 grms. per cub. m. In connexion with this experiment, it should furthermore be noted that in the refinery other amounts of mechanical energy may be converted into electrical energy. Thus we believe that theory, logic, and experiment have sufficiently proved that in a sugar refinery explosions are due solely to electrical causes.

In the original investigation,[2] it was suggested that hitherto the dangerous nature of floating dust had been over-estimated, while that of quiescent dust had been under-estimated. It is true that the dust lying in thin layers on the floors, walls, beams, machines, etc., in rooms in which sugar is crushed, may not be the immediate cause of an explosion; but it can play a part in enormously increasing the extent of an explosion or a fire. Thus, by the pressure wave of any kind of an explosion (not necessarily of dust), or by the draught of air rising from a building on fire, this quiescent dust may be whirled into rooms (or spaces not entirely enclosed), filling them with a cloud of dangerous concentration, capable of exploding in contact with a light, and of enveloping the whole place in flames.

An idea of the danger menaced by dust lying about the floor, walls, ceiling, etc., of a room can be obtained by calculating the height of the layer which on being whirled into a cloud would be capable of producing a dangerous concentration. In the case of a room 3 metres (9 ft.) high, 24 metres (78 ft.) wide, and 24 metres (78 ft.) long, the height of the layer of dust for the formation of a concentration of 21 grms. per cub. metre would have to be only 0·054 mm. (0·0022 in.) in order to constitute a possible source of considerable danger in the refinery.

Prevention of Sugar Dust Explosions in Practice.

It has been shown that the electrical dust explosions that are possible in the refinery are limited to no particular concentration of cloud, and that the danger of electrical ignition exists mainly in the disintegrating machines, where the finest dust is present in the highest concentration. Even the use of a powerful current of air cannot sufficiently diminish the density of this fine dust, seeing that it is constantly in the state of formation. Nor can it be removed as soon as it is

[1] *Vereinszeitschrift*, 1923, 144. [2] *I.S.J.*, 1922, 576.

formed. Between the moments of formation and removal there must always be a time interval, be it ever so small; and even such a brief period as this might suffice for the occurrence of an explosion.

Therefore, one must endeavour to limit the formation of dust to the greatest extent possible. This can be realized by the selection of suitable subdividing machines, so-called "free disintegrators," and best of all by not grinding too finely. A certain coarseness should be aimed at, and the finer grades of powdered sugar should be obtained by the less harmful operating of sifting.

Since quiescent dust is the best promoter of an explosion, it must nowhere be allowed to accumulate. This can be achieved by greater cleanliness in the operation of milling, by conducting to a good altitude the pipes leading away the dust, and by destroying the dust at the end of the de-centralized dust-separating plant, namely by precipitating it with water. Dust chambers and tubular filters must be avoided.

Then, since the electric energy always attached to the dust particles is the real potent agent, it must be rendered harmless as soon as ever it is possible after its formation. This can be done by conducting to earth, or by electrical neutralization, that is, by the transformation of the plus or minus charge to neutrality. Since, according to our present knowledge, the electrical state depends on an excess (—) or a deficiency (+) of electrons, it is necessary only to add or abstract electrons. Physics already points to the way of doing this, and suitable apparatus for putting it into practice is being developed.

Discussions of the Chemical Section of the Java Sugar Technologists, 1922 Meeting.

At the Congress of Java Sugar Technologists held in April, 1922, round-table discussions on various matters connected with the chemical and mechanical aspects of raw and white sugar manufacture took place. Some of what would appear to be the most generally interesting points emerging from the deliberations of the Chemical Section are here reproduced.

Modern Methods of Juice Clarification.

Sulphitation process.—Mr. G. Loos mentioned that some of the factories of the Colonial Bank are still sulphitating cold; while The Chairman (Dr. van der Linden) stated that in all the H.V.A. plantation white sugar factories hot sulphitation is applied, the temperature sometimes reaching 80-85° C., since experience shows that (provided the operation be carefully supervised) no difficulty at all exists under these conditions. Replying to Mr. H. Schweizer, he said that the reason why such a high temperature is maintained (and not one such as 60° C.) is the result of experiments made by Mr. Altman, who in practice had observed that by keeping up to 85°C. lighter and clearer juices are obtained. In some cases, however, he (Dr. van der Linden) had found that an opalescent juice results on sulphitating at 85° C. Mr. Schweizer replied that he saw great danger in using high temperature, any possible mistakes which might occur being so strongly accentuated. He applied a temperature between 50 and 60° C. On the other hand, The Chairman considered this range to be too low, though in the factories of the H.V.A. there was no fixed rule other than that the temperature should be held between 60 and 85°C.; somewhere between 70 and 75°C. was the average, which range is considered to have all the advantages of hot sulphitation without

its disadvantages. Lastly, THE CHAIRMAN raised the point regarding the degree of sulphitation, reminding the meeting that the Experiment Station gives 100 mgrms. per litre as the maximum limit, and 30 as the minimum; and he asked to what extent in practice these limits are upheld. Mr. LOOS replied by stating 60–80 mgrms. to be the general limit. After this a discussion took place regarding the best method of determining the acidity due to SO_2. Most of the speakers gave preference to direct titration with standard sodium or calcium hydroxide of low normality.

Mr. VAN DER HAAR asked whether during sulphitation the juice should be kept strongly alkaline, or whether the directions prescribed by the Experiment Station should be adhered to, these specifying that sulphiting and liming should be so regulated as to remain in the neighbourhood of neutrality, leaving an alkaline reaction at the finish. He had, however, carried out a test at the Poppoh Sugar Factory in which the reaction was kept acid throughout the sulphitation operation, a brilliant juice being obtained, but the installation was such that it was extremely troublesome to work at the right reaction without the occurrence of inversion. THE CHAIRMAN was not favourable to this method of working, as by means of it the phosphates are not eliminated. In the dilute acid medium, the phosphates formed are later transformed into mono and tri-calcium phosphates. In the first vessel of the multiple effect evaporator a strong deposition of tricalcium phosphate takes place; while moreover the degree of acidity of the juices increases so that the danger of inversion is not precluded. Similarly, Mr. EGETER was not in agreement with such acid working in sulphitation, it being a fact that at high temperatures many colloids coagulate better if an alkaline reaction is indicated. He believed the deposition of phosphates during evaporation to be due rather to the fact that the tri-calcium phosphate in the colloidal state in the juice is precipitated as the result of the heating. Mr. SCHMIDT also was opposed to acid working in sulphitation, the juice at the Redjosarie Sugar Factory always being kept alkaline. He has investigated which reaction gives the best result, and had found that in alkaline working a decidedly finer juice is obtained than in acid operation. THE CHAIRMAN confirmed this, and added that though in acid working the colour of the juice might be distinctly better, yet there usually remained an opalescence. Resuming, it would appear that the general opinion is that during sulphitation the juice should be kept slightly alkaline; that in finishing off most factories proceed to a slight acidity; and that on the other hand others keep to a very slight alkalinity.

Carbonatation process.—Mr. LOOS said that he would like to enquire whether most carbonatation factories are still applying De Haan's process, as he had heard that some had reverted to the ordinary double mode of working, trouble in the colour of the white sugar having been experienced owing to an insufficiently satisfactory clarification. Mr. DE HAAN replied that there are only two carbonatation factories not using his process, and that he was unaware of any difficulty whatever having been experienced in its operation. A question having been raised regarding the form of the carbonatation tanks, Mr. DE HAAN said that round ones are preferable to square, as in the latter it is difficult to get a good end-reaction.

Defecation process.—At this point THE CHAIRMAN remarked that till now the discussion had concerned methods of working in white sugar manufacture, and he asked if anyone had something to say about raw sugar manufacture. Mr. SCHWEIZER responded by raising the question of the "after-defecation" of the juice, whether it is really necessary or not. He was of the opinion that in the ordinary defecation method, boiling-up is not essential, though in the defecation

sulphitation process heating to 90–95° C. in pre-heaters is quite sufficient. In reply to a question, THE CHAIRMAN stated that in the H.V.A. factories the acidity of the defecation thin-juice varied between 30 and 50 mgrms. per litre, one above 60 mgrms. seldom being found. Mr. H. T. M. VAN NESS reminded the Conference that the acidity of the thin-juice in defecation factories meant little, and that it is sufficient to see that the reaction is slightly alkaline to litmus. In some factories an acidity of 30 and in others one of 100 mgrms per litre occurs. Mr. SCHWEIZER concurred in the belief that the acidity of the thin-juice indicates little, and at Assembagoes, for example, values of 200 mgrms. per litre are encountered, it being therefore difficult to state definite limits. Turning to the matter of the amount of lime used in defecation, he asked his colleagues whether they had last season found large doses necessary, since in one factory he had found that 10-12 litres must be added, an enormous precipitate being sometimes produced. This possibly was due to an unusually high phosphate content of the juice, and samples of the press-cake had been sent to the Experiment Station for examination for the determination of this point. THE CHAIRMAN and Messrs. LOOS and EGETER had observed the same phenomenon during the last campaign, it being necessary to use 25–30 and even sometimes 40 litres of milk-of-lime, Such high additions, however, result in viscous massecuites. By systematically decreasing the lime, the result was the improvement of the curing, this being due to the fact that the formation of slimy calcium salts arising from the attack of the "glucose" by the large amount of lime had been avoided to some extent. Mr. SCHWEIZER remarked that at Assembagoes much molasses was continually obtained, but that its purity sank when one worked with acid juices in the boiling house, the acidity amounting to about 200 mgrms. (as SO_2) per litre. It is the H-ion concentration that controls the hydrolysing power of this acidity; phenolphthalein indicates all the acids present, though all may not have an inverting action.

NEW METHODS OF JUICE CLARIFICATION.

In the first place, THE CHAIRMAN remarked that he regretted that MR. DE RUYTER DE WILDT was not present at the meeting in order to be able to give some information regarding his new clarifying process, which in principle consists in boiling up the raw juice with fine chalk. Since a patent has already been applied for, and the rights have therefore been protected, he presumed that there would be no objection to the open discussion of this new method of juice clarification. MR. VAN DER HAAR said that after many tests it had been possible to find a kind of chalk which gave very favourable results in use. Juice thus treated filtered excellently, giving a very light-coloured liquid; but the application of other forms in which $CaCO_3$ occurs in nature (when powdered) gave unsatisfactory results; and the good effects that have been observed must be ascribed to the use of a material which is extremely voluminous and possesses a very regular and fine structure. Juice which had been treated with a sufficient amount of such chalk was slightly acid or neutral to phenolphthalein, and though light in colour was cloudy owing to suspended phosphates. But the success of the process depends on whether the particular kind of chalk is obtainable locally, and so far this does not appear to be so.

Mr. EGETER pointed out that with present methods the principal means of clarification which is applied is a physical one—namely heat, which coagulates a large portion of the emulsoid colloids. Then the question becomes the best way of removing these coagulated colloids from the juice, direct filtration being an impossibility, owing to the pores of the cloth soon becoming entirely obstructed

by elastic particles. A filtering medium is necessary in order to keep the pores intact so far as possible, this being provided by the addition in some way or other of insoluble particles, as by the formation in the juice itself of calcium sulphite, or by the admixture with the juice of some substance already formed. In the present process it is the second alternative that is applied, but a great difficulty may stand in the way. One of the principal conditions is the regular distribution of the substance added for the purpose of giving structure to the elastic particles; and if this is not fulfilled then, as the result of the difference of specific gravity, separation takes place, making proper filtration impossible. However, he was able to say that by the use of certain kinds of chalk the cohesion of the particles occurred very nicely without the addition of any other substance. In reply to a question Mr. VAN DER HAAR stated that apparently the chalk which he had used in the practical tests at the Kremboong sugar factory had originated from the production of magnesia; while Mr. EGETER made the further remark that any other insoluble substance giving an aqueous suspension which could easily be filtered might presumably be used.

Mr. VAN DER HAAR desired to direct attention to the use of infusorial earth (kieselguhr) which has lately been found in quantity in Java; and he expressed the wish that practical tests should be made with this substance. By the application of purified infusorial earth, filtration proceeds with remarkable facility, and laboratory tests had shown him that it could be regenerated by heating, the tricalcium phosphate remaining behind increasing the filtering power of the material. Further, the price of infusorial earth is relatively small. Mr. LOOS remarked that alkaline infusorial earth could be obtained in Java, and that it was being put on the market under a fancy name. Mr. EGETER said that "Filtercel" was a certain kind of infusorial earth, which had been well purified; and Mr. VAN NES added that he had had experience with "Filtercel," and had observed that with its use filtration proceeded brilliantly.

SYRUP CLARIFICATION USING THE BACH PROCESS.

THE CHAIRMAN, referring to the Bach process of purifying and filtering evaporator syrup, said that he had not operated it himself, but that he understood that its advantage consisted principally in making evaporator syrup readily filtrable, thus obtaining a fine, clear liquor from which a nice sugar resulted without a higher yield being obtained. Therefore, the advantage is one rather of the quality than of the rendement. Mr. SCHWEIZER considered that the question of yield had not yet been finally settled, though that of quality in the application of the Bach process had been established. He could not understand why the costs at the Kartasoera sugar factory had been so high. Mr. LOOS added that in ordinary sulphitation factories the costs were not always small, some having a sulphur consumption of 70 kg. per 1000 piculs of cane, and even somewhat higher than this. Mr. SCHWEIZER said that sweetening-off was effected first with clarified juice and later with water, these washings all being returned to the juice about to be evaporated.

Mr. SCHMIDT explained that the reason why at Petroekan the costs have been high was that they were obliged to add high amounts of lime in the preliminary stage of clarification owing to the varying quality of the juice and to the circumstance that much juice had been brought along by the cane. He presumed that with proper juices the amount of lime would not require to be so high, and that the Bach process would give distinctly favourable results in the second stage of clarification. Still, the costs are not small, owing to the greater amounts of lime

and sulphur used; while, further, extra sweet-water must be evaporated, which involved some difficulty at Petroekan, where the capacity of the evaporators is on the short side. At present he estimated the extra costs of the Bach process to be 10 cents per picul of sugar, against which one must place either better sugar, or else higher yield.

The Formosa Sugar Crop, 1922-23.

His Majesty's Consul at Tamsui (Mr. G. H. Phipps) has forwarded to the Department of Overseas Trade the following complete statistics of production of sugar in Formosa in the season 1922-23.

	Piculs.
Centrifugals	5,801,220
Browns	106,059
Total	5,907,279
	(equivalent to 348,825 tons).

The 1922 figures are appended for the purpose of comparison:—

	Piculs.
Centrifugals	5,736,509
Browns	147,894
Total	5,884,403
	(equivalent to 347,474 tons).

This year's production of centrifugals thus shows an advance of 64,711 piculs over 1922, which was realized in spite of a reduction, owing to the high price of rice at the time of planting, of nearly 50,000 acres in the area under cane. This result is attributed to the following causes:—

(1) Larger proportion than usual of fields planted with fresh cane and consequent higher sugar content.

(2) Failure of the mills, owing to the rise in the price of sugar, to retain a sufficient quantity of canes for seedlings.

(3) Strict prohibition by the companies of pilferage of canes for eating purposes.

Browns, on the other hand, owing to the low prices obtainable, show a further falling off.

The average sugar content for 1922 and 1923 for centrifugals is returned at 9·54 and 9·57 respectively, an improvement of 0·03 per cent. for the current year.

Turning to the prospect of the 1923-24 season, all planting is now finished and, although two of the smaller mills have not yet sent in their returns, the total area under cane may be placed at 301,750 acres. This is a considerable advance on the area planted last year, and is, indeed, some 10,000 acres in excess of the estimate of the companies themselves some time ago. Taking the yield of cane at the same figure as the 1922-23 season, namely 550 piculs per "ko" (say 30,350 lbs. per acre), this acreage of planting would give a total production of cane amounting to 66,622,600 piculs. On the basis of a 9½ per cent. sugar content, this would yield 6,329,147 piculs of sugar, but, allowing for the excessive optimism generally in evidence at the outset of the season, the round sum of six million piculs (354,300 tons) would perhaps be nearer the mark. Much of course depends upon the weather during the next few months, as one bad typhoon might cause damage necessitating a downward revision of the above estimate. The reported failure of the mills to retain a sufficient quantity of canes for seedlings (and the consequent necessity of utilizing the ratoons of the previous crop) is also calculated to have an adverse effect upon next year's output.

Hawaiian Report on Agricultural Machinery and Implements.

Mr. J. A. Verret, Chairman of the Committee on Agricultural Machinery and Implements, has issued a report to the Hawaiian Sugar Planters' Association under date of September 21st, 1922, of which the following is a summary:—

The Committee believes it extremely important at this time to call attention to the introduction of any new implements which are labour-saving, or, by increasing yields, increase the sugar output per man. Efforts should be confined not only to the mention of new implements, but also to the discussion of any new agricultural practices, or the modification of old methods involving the use of agricultural implements introduced as the result of the labour shortage.

Some practices have been entirely discontinued or greatly modified. For instance, less cutting back is being done, followed in some cases, by less or no deep ploughing, ploughing and hilling up. We believe that this subject is important enough to have our continued serious consideration.

With this object in view a letter was addressed to the managers of all the plantations. From the replies we see that tractors continue in favour. Their uses are increasing not only for ploughing and furrowing, but for cultivation. Off-barring, stubble shaving, and digging are not practised quite as extensively as formerly. Ploughing and hilling up of cane is being done less and less on both irrigated and unirrigated plantations.

Mr. F. F. Baldwin, of Hawaiian Commercial & Sugar Co., wrote: "We have been doing practically all our furrowing with 60 h.p. Best tractors, pulling three ploughs each, with good success. Most of the harrowing has also been done with these tractors, and better than the steam plough, as the weight of the tractor travelling over the land crushes a great many hard lumps of soil. More harrowing is being done than in former years, and consequently a very much better job is being made of furrowing, which naturally speeds up planting. We are using more 9 in. rice ploughs in hilling up. Formerly we used smaller ploughs, but we find that the 9 in. plough does better work. In most fields we pull these ploughs three times each side of the cane row and through the centre, followed by the hill up ploughs. Cleveland tractors have been used for pulling the hill up ploughs, but not with any great success."

Mr. John Ross, of Hakalau, states that: "In round ploughing we are firm believers in the Spalding deep tilling ploughs. They may be a little slower and more expensive, but the work done by them when the land is properly cut for their use is *par excellence.* We have discontinued the use of stubble diggers and disc ridging cultivator, and have modified the old practice of high hilling up, in fact, have practically discontinued it. Sixty per cent. of all our ploughing is now done by Yuba tractors instead of mules."

Mr. William Pullar, of Honomu, in regard to the thorough preparation of a field before planting, brings out an extremely important point, when he says that: "Since the introduction of the tractor, the ploughing on unirrigated plantations has been deeper, and with the better preparation of the land before planting, there is less subsequent cultivation necessary. Except for hilling up, small ploughing on young cane is seldom practised, and weeds are controlled more by light harrowing."

Mr. Broadbent, of Grove Farm, says that: "This year we have decided to use only cultivators and a light hilling plough, capable of being handled by one mule, in our ratoon work. This plough is one that we have designed and is a great improvement on our old ploughs."

Mr. Burns, of Koloa, is using an Avery Fertilizing Spreader to apply reverted phosphate in the line ahead of planting, and finds that it works well. Ewa and Waianae report that off-barring, hilling up, and cutting back have been discontinued on those plantations. Mr. Broadbent, of Grove Farm, has developed an attachment for a Planet Junior cultivator with which he is able to keep not only between the rows, but in the cane itself free of weeds. We understand that where it has been used no hoeing was necessary.

New Planting Machines.

Mr. Broadbent, of Grove Farm, has also designed a cane-planting machine which allows planting at a most remarkable figure, his report on this machine being as follows:—"I have designed an outfit for planting straight lines of cane that is very satisfactory. Five men run it and plant 450 bags of seed in nine hours, that amount being the most we were able to furnish in any one day during the time we were planting with the new machine. The cane has come up excellently on the 60 acres planted, and my only regret is that I did not get it going earlier, so that we could have planted all our mauka land with it. At present it seems that this system is only suitable for unirrigated or semi-irrigated lands, the advantages being as follows:—Saving of labour in planting, and consequent saving in cost; more even dropping and covering of seed; and consequently better stand of cane."

Mr. Larsen, of Kilauea, has introduced several modifications and additions to Mr. Broadbent's planter, and gives the following data in regard to the improved machine:—"By the use of this machine, a 45-Holt tractor, and nine men, we are able to furrow, plant, and cover about 12 acres a day. The planting is perfect, and we have never had a better stand than in the areas planted with this machine. The total labour cost of furrowing, planting, and covering comes to about $1.50 per acre; while the cost, including gasoline, oil, etc., is about $2.50 per acre. The cost of distributing the seed is also reduced since the wagons or trucks with the seed can go right into the field, thus eliminating the use of pack mules. The covering plough is attached behind. It has a rail attachment which pushes away the surplus soil from over the seed, the idea of this rail attachment being obtained from Mr. Broadbent's covering-plough. There is also a seed box attached to the covering-plough. This is used to fill in any spaces left blank by the planter. The man holding the covering-plough picks the seed from the box and throws it in front of the plough when any blank spaces occur. The first planter of this type was made by Mr. Broadbent, but in it the seed was dropped by hand into the furrow. In our planter chutes were added for placing the seed, as well as a table; another planter is now under construction in which the placing of the seed into the chutes will be done automatically by an endless chain conveyor. The plough is drawn by a 45 H.P. Holt. It has made all our level ditches and straight ditches during the past year, saving a great deal of hand ditching."

"Suchar" is the latest carbon to be put into operation in Louisiana. It is a product of the black liquor from paper mills, and is being developed by the Industrial Chemical Co., of New York. It will be tried on the large scale at Southdown, Terrebonne, La., during the coming grinding season for the refining of foreign raws on toll.

Sir Ernest Jardine, Bt., presiding at the Third Annual Meeting of Home Grown Sugar Limited, referred to the improvements and extensions of the Kelham Beet Sugar Factory now being made under the supervision of their Dutch technical friends, and expressed the hope of the Board that the results of the coming season would enable the Company to pay a dividend on the reduced capital next year for the first time without calling upon the Guarantee of the Government.

Recent Work in Cane Agriculture.

Het Wortelrot op Java, speciaal in Verband met de Rietsoort E K 28 (Root Disease in Sugar Cane in Java, with Special Reference to the Variety E K 28). *J. Kuyper. Mededeelingen van het Proefstation van de Javasuikerindustrie. 1923, No. 4. (Summary by the author).*

No special fungus or bacterium has been found as a causative organism in Java root disease, nor have the studies in other countries brought any certainty on this point. The author has therefore confined himself to a careful investigation of the factors which appear to him to be responsible for its appearance. It has been proved that anaerobic conditions of the soil, especially connected with bad drainage, and excess of moisture generally, are particularly favourable to its occurrence. Thus, in badly drained lands, where the water level is high, E K 28 can hardly be grown, whereas in deep, rich, sandy soils with good drainage it is by far the most productive variety.

Anaerobic conditions are favoured by the presence of much decaying vegetable matter in the soil, and the longer the fallow after the cane crop has been harvested the better the following crop. There are two systems of cane rotation in Java, one with an interval of two years, and the other with three; and the latter appears to be the best with regard to this disease. Besides this, inconstancy in the water content of the soil, and quick and numerous changes in this respect, appear to aggravate the results of the attack. The author discusses the questions of soil sickness and organic poisons in the soil, but sees no necessity to introduce these ideas for an explanation of root disease. It is not spread by the sets, but succulent plant material, which is readily attacked by putrefying organisms, favours the disease by causing anaerobic conditions around the young roots.

The Java planters have feared that the disease is on the increase, but the author, by a large number of figures and tables, shows that this belief is not justified. Taking E K 28, which is specially liable to its attacks, the planting of this variety has increased from 2 per cent. in 1916 to 40 per cent. in 1922; and, while there is in reality more root disease than formerly, this increase bears no relation to the increased area under this variety. It has therefore increased absolutely, but not relatively.

Climatic conditions have great influence on its appearance, one year showing but a small area infected and another a much larger one. The dominant influence of climatic conditions on the crops obtained from different varieties of cane is dealt with in this connexion. When root disease appears in a certain field, there may be none in the next crop grown on the same spot. This depends largely on the local cause; when this is amenable to treatment, and the treatment of the soil has been wrong, it will disappear with improved methods, but if the field is in an unfavourable situation which cannot be remedied, the disease may appear again and again.

Notwithstanding its susceptibility to root disease, the variety E K 28 is the best one in Java, and this is even so in many plantations where root disease is prevalent. The average yield of the 40 per cent. under this cane in the island is much higher than the average crop of the whole cane area. The author urges the planters to fight root disease by means of better cultivation methods, i.e., more care in drainage, cultivation, tillage and irrigation, so that they may reap

the full advantage of this splendid cane. He also emphasizes the importance of this careful plantation work, for fighting all the pests and diseases which invade the cane fields of the island.

COIMBATORE SUGAR CANE SEEDLINGS IN THE UNITED PROVINCES. *G. Clarke, Mohd. Naib Hussain, and S. C. Bannerjee. Agricultural Journal of India. Vol. XVII, Part V, September, 1922.*

This is an account of the trial, at Shahjahanpur Sugar Station, of the first two series of seedlings raised at the Coimbatore Cane-breeding Station, and distributed for testing under various North Indian conditions. These conditions in the United Provinces are chiefly influenced by the extremely short period of active growth, which is stated to last for four months, June to September, during which the monsoon prevails. The following characters are given as of primary importance:—strong root system, early and vigorous growth, yield of cane, percentage of juice, sucrose content and early ripening; and, in addition, resistance to disease and erect habit as also of importance.

The methods of obtaining improved varieties practised on the farm are (1) the investigation of Coimbatore seedlings, (2) importation of canes from other countries and (3) the isolation of pure lines of indigenous (Indian) canes. All of these methods have given definite results. The first presents great possibilities of maintaining a regular supply of new and vigorous canes of better quality than those at present grown, which is essential in order to establish improved sugar cane cultivation and a permanent increase in the production of sugar and gur. The work at Coimbatore commenced in 1912 and the first series of selected seedlings was received at Shahjahanpur in 1918, after which date some have been received each year, up to a total at the time of writing of 37. These are as follows:—1918 Co 201-216, 1919 Co 218-221 and 223, 1920 Co 224-227, 1921 Co 229 and Co 234-238, 1922 Co 239-244. The work of selection cannot be completed at Coimbatore, but must be supplemented by further testing in the environment in North India where they will be ultimately grown.

The method devised on the farm is to plant the sets received at sowing time in the middle of the main crop field and to treat them in exactly the same way as the field crop. During the first year preliminary observations are made of their general agricultural characters, and the juice is analysed at the close of the season. No elimination has thus far been practised at this point, although it is hoped that it may be possible later on to discard those that are obviously unsuitable at this time. In the second year there is as a rule sufficient material to plant up one sixtieth of an acre or one row in the field. Observations are made of agricultural characters, such as growing capacity, vigour, habit and freedom from disease; and ripening tests are started in November, the period at which the earliest indigenous canes are ready for crushing. These tests are continued monthly during December and January. Elimination now takes place of those obviously unsuited to the soil and climate, the causes for rejection being poor growth and habit, liability to the prevailing smut, and inability to stand the low temperatures of December and January. The selection of the first series was not rigid in their second year, and several seedlings have been carried on to a field scale, which according to later experience might safely have been rejected. In the third year one-sixth acre plots are planted and of these one-tenth acre blocks are used for outturn tests, yielding 70–100 maunds (one maund = 82·3 lbs.) of cane, the whole of which is crushed. Reliable information can now be obtained as to yield of cane per acre, time of ripening, juice expressed per 100 parts of cane, sucrose per 100 juice, purity of juice, sucrose per 100 cane, quality of *rab*, and a fairly vigorous selection may

be made. In the fourth year the field experiments are continued and at the end of the season a final selection is made of seedlings for large scale growing and the production of sets for distribution. The final test of the Experimental Station results is made by the cultivator.

The results obtained in the examination of the seedlings received in 1918 and 1919 are then given in detail. Of the former, Co 214 is the selection definitely made at Shahjahanpur for extended trial in the United Provinces, and in the second series, whose agricultural characters appear to be better suited to Shahjahanpur conditions, after three years four have been selected for further trial on a field scale. In the summary at the end of the paper the authors conclude that the systematic examination of the first series of Coimbatore seedlings may be regarded as satisfactory. They are the first seedlings produced and tried on a field scale in India, and experience of the behaviour of the various types had to be gained. The majority of the seedlings proved, under the farm conditions, to be of poor quality, but Co 214 appears to be of considerable merit and has emerged from the rigorous tests as a type of cane suited to the conditions of at least one important tract in the United Provinces. A wide range of forms is required for all the climatic and soil conditions of the tract, and the authors suggest a wider choice of crosses at Coimbatore, together with a more effective and rigorous preliminary examination in order to eliminate in the early stages such obviously unsuited seedlings as Co 203, Co 207 and Co 209. This is more than likely at the Coimbatore Station, where experience can only be gained by the publication of trials under North Indian environment such as the one now before us.

RECENT DEVELOPMENTS IN THE STUDY OF THE NATURE OF MOSAIC DISEASE IN THE SUGAR CANE AND OTHER PLANTS. *Julius Matz. Journal of the Department of Agriculture of Porto Rico. Vol. VI, Part 3, July, 1922.*

Mosaic disease in plants has been generally considered as infectious and caused by ultramicroscopic organisms, most investigators apparently relying on cultural methods, and having failed in these have left the matter as inexplicable. The study is now proceeding along cytological lines with careful observations on the cell contents of healthy and diseased tissues; and recently new light has thus been shed on the subject, and there is some prospect of the causes of this mysterious disease being ultimately cleared up. The author started his cytological studies in 1919 and soon found that, in advanced stages, small portions of the internal tissues of diseased stalks became bleached or coloured light or dark brown. In such places the cells were seen to be filled with compacted, densely granular, often slightly browned plasma, these granules being smaller than ordinary bacteria and appearing like nuclear grains distributed through the mass of cytoplasm; it was found impossible to determine their exact size or form, because of the imbedding material.[1]

IANOWSKI in 1903, in studying tobacco mosaic, made drawings of bodies attached to the nuclei, but disregarded them as active agents in causing mosaic, because of the known free filtration of the virus through porcelain filters, which these bodies were of course much too large to penetrate. He found, however, abnormalities in the cytoplasm due to the action of mosaic and claims to have observed bacteria which he credited with being the causal agents of the disease. On staining with Loefler's solution, the protoplasm and chlorophyll grains became red, while the nuclei and bacteria turned blue. The author repeated this staining and confirmed these results excepting that he failed to find the bacteria.

[1] Thus far published in Journ. Dep. Agr., Porto Rico, iii 4, October, 1919.

Recent Work in Cane Agriculture.

Reverting to recent work, MATZ describes the results obtained by two workers. In 1921 KUNKEL observed, in the cells of the leaves of maize plants attacked by mosaic, large bodies attached in various positions to the nuclei strikingly similar to those drawn by IANOWSKI, and these he regarded as the active agents in the disease. He also confirmed the author's observations of cells in the stalks, with compacted, granular, slightly browned substance.

PALM (in 1922) working on tobacco mosaic, found in a large number of cells peculiarly formed bodies or very small granules similar to the author's and KUNKEL's in the diseased cells, frequently conglomerated or filling the whole cytoplasm of the cell. These granules he compares with those met with in the virus of variola infection of men and animals and has accordingly named them *Strongyloplasma Ianowski*, in recognition of that observer's claim to have detected minute bacteria in tobacco mosaic twenty years ago. If these granules turn out to be causative of mosaic, then in the sugar cane there will be a different specific name because the tobacco organism cannot induce mosaic in the sugar cane.

The author has now made a further cytological study of the diseased tissues in sugar cane mosaic, using Jeffrey's formula of corrosive sublimate with picric acid with the addition of 5 c.c. of glacial acetic acid. He submitted the diseased and healthy tissues of the cane leaves to special treatment which he describes, transferred them to melted paraffin and cut sections which he stained in various ways. The main points to be noted in his sections (of which he publishes two photographs) is the very evident destruction of the chlorophyll grains. In the diseased tissues they are evidently misshapen and broken up, and in the stained sections appear merely like ink spots, one or two in a cell. This destruction he considers fixes the seat of the disease more definitely, as apparently the protoplasm and cell wall are not affected. In very early stages of the disease the change begins with a reduction in the size of the chloroplasts, and all stages of this reduction are observable.

GUMMING DISEASE OF THE SUGAR CANE. *Julius Matz. Journal of the Department of Agriculture in Porto Rico. Vol. VI, Part 3. July, 1922 (20 pp.).*

This disease was first noted in Porto Rico, in February, 1920, in two car loads of cane sent from Trujillo Alt to Central Vannica to be ground. A special inspection was at once made of the canes being milled all over the island, and a circular issued in Spanish with the following information. The chief sign of the presence of the disease was a honey-coloured exudation on the cut surfaces of the canes, with, in advanced stages, brown red fibrovascular bundles. This agreed with the disease described by COBB in Australia and studied by E. F. SMITH: cultures were made of *Bacterium vascularum*, which causes it, and the Otaheite cane, inoculated with it, showed the gumming in three months' time. Immediately a special survey was made throughout the island and the disease was located in only one small area of 15 km. extent around Trujillo Alt. It was found chiefly among the older canes, and of these Cavengerie appeared to be least affected; of the newer kinds Yellow Caledonia was apparently immune; the quest after resistant varieties was the only method of fighting gumming. It was considered probable that the heavy rains of the season had helped to bring out the disease.

In the next season (January, 1921) the disease was found to be much more widely spread, being found 25 km. to the west and 15 km. to the south of the original tract; and in 1922 it had obtained a hold in the interior and had spread in all directions along the coast.

The earliest record of gumming comes from Brazil, where DRANERT drew attention to it and affirmed that it had assumed alarming proportions during the

six previous years; but in 1894 it had largely disappeared, owing to the introduction of resistant varieties such as Cavengerie. In the latter year it was reported from Mauritius by Boname. In 1893 Cobb found it in New South Wales and suggested its bacterial origin; and it was found two years later in Queensland. In 1902 Greig-Smith isolated the bacterium, and E. F. Smith two years later studied it, and, with material obtained from Australia, inoculated Otaheite, which developed the disease in three months.

In 1914 and 1916 Groenewege discussed the disease in Java, and found it identical with that in Australia; but in 1920 Wilbrink pointed out that it was probably different in that the gummy exudation did not occur anywhere in Java. The masses of gum which stop up the vessels and exude on the cut surfaces are merely the gummy matrix of the zooglaea stage of the bacterium, and this is found both naturally in the cane and in pure cultures, and its absence in the Java disease causes the author to agree with Wilbrink in considering the Java disease as caused by another organism.

The economic results are serious, in that the growing point of an infected stem is destroyed, and therefore ratooning is prevented; also the gummy substance interferes with the recovery of crystallizable sugar, and there is rapid decay of the tissues in canes that have been cut. Resistance varies greatly in different kinds of cane, but possibly almost any one would suffer in time if planted among those that are susceptible. This is of importance in Porto Rico, for most of the fields consist of a mixture of Cavengerie, Cristalina, Rayada, Yellow Caledonia, Otaheite and its close ally Calancana. It was impossible therefore to estimate the losses caused by it. These are specially serious among ratoon crops, although not always obvious because of the deaths among the young shoots. In one case a field was reported to have recovered, when it was found on examination that this was due to all of the Otaheite having been killed out.

The symptoms are:—Firstly the gummy exudation already mentioned, usually lemon yellow and thickly gummy, but varying to greyish yellow and almost watery. There is a peculiar appearance in the young leaves; before unrolling these show pale green to almost white patches, often sprinkled with small dark red spots or short narrow streaks. In older stages the inner leaves show dead grey stripes 1 cm. wide towards the middle of the blade, due to partial stoppage of the vessels. This distinguishes the disease from withering due to natural causes or injuries, where death proceeds from the edges inwards. The tops remain erect and cannot unfold because of these dead stripes. Later, an odourless decay sets in in the growing points, and a red coloration is seen between the fibrovascular bundles there, often accompanied by the death of the phloem. In many cases stunting of the canes is noticeable, as well as longitudinal depressions on the internodes. Among these symptoms it becomes necessary to distinguish between those that are primary and the secondary ones. The former include the exudation of the gum, the leaf markings and the death of the growing points, while the reddening of the bundles, stunting, etc., may not occur. The leaf symptoms are of special significance, because by their observation it becomes possible to detect the disease without cutting the canes; and, as will be seen, perhaps the main mode of spreading the disease is by the cutting implements. Those canes showing leaf markings should be omitted in harvesting and cut afterwards and destroyed.

The spread of gumming in Porto Rico is now rapid, and it is becoming epidemic. It has been found that it can be spread by cutting implements, and probably also by driving rain and passing insects, as the tender tissues of the tops

are specially susceptible. In a series of experiments described, the author was unable to pass it through the soil, and the roots do not appear to be a favourable medium. Varietal tests were also made and a graduated list has been prepared. In this list Otaheite and Calancana, Rayada and Cristalina, B 376 and three Porto seedlings are given as strongly susceptible; six varieties are slightly so; three, including B 208 and D 625, proved only susceptible in young stages; while no fewer than 26 were resistant or immune. The outlook has thus become hopeful. The rapid spread has followed the distribution of Otaheite in the country. MATZ advises the extended planting of the red cane (Cavengerie) and Yellow Caledonia, and the replacement of Otaheite by D 109 on hill lands.

C.A.B.

The Czecho-Slovakian Sugar Industry.

Department of Overseas Trade Report.

The 1922-23 Sugar Season.—In last year's report mention was made of the fact that any profits accruing from the sales of sugar abroad were to be divided between the Government (50 per cent.), the beet growers (43 per cent) and the manufacturers (7 per cent.). The net sales of last season's crop abroad resulted in a considerable loss which was equally divided up between the raw sugar factories and refineries according to the scale already fixed upon by agreement.

The 1922-23 season was entered upon with no surplus stock in hand. After the abolition of State control, there was a general desire for the introduction of more economical and rational methods of administration, and great efforts were made to reduce costs of production in order to enable Czechoslovak sugar to compete in the international markets. By far the most important factor in this direction was the price of beet, which, during the season 1921-22, was no less than Kr. 26 per quintal or 13 times higher than in the season immediately preceding the war. In the spring of last year the manufacturers approached the beet growers with a view to inducing them to reduce their prices and to preserve an industry so closely allied to agriculture. These negotiations resulted in a compromise being reached fixing the price of beet at 17 crowns per quintal, but even this price proved to be relatively too high when the Czech crown rose so rapidly during the latter part of the year.

In October last the Czechoslovak Sugar Syndicate, which was formed to tide over the difficult period after the abolition of State control, was dissolved and manufacturers were given absolute freedom to dispose of their stocks abroad to the best advantage, after provision had been made for supplying home requirements amounting to approximately 3½ million quintals. In order to eliminate competition amongst the manufacturers in supplying local requirements, an agreement was arrived at on October 13th, 1922, securing a quantity of 4,777,125 quintals to the home market and prescribing the amount of sugar to be turned out by each individual refinery. This agreement was not made for the purpose of regulating prices, its intention being merely to avoid the dislocation of markets.

Last year (when beets cost Kr. 26 per quintal) the price of sugar was fixed at Kr. 650 per quintal, but when prices began to fall on the international market, the price of Czechoslovak sugar was found to be far above the prices ruling abroad and it was accordingly reduced to Kr. 400, but on November 18th was again increased to Kr. 405. This latter price included all taxes, as the manufacturers only received Kr. 400 per quintal net. As the total sugar production for 1922-23 is estimated at approximately 7 million quintals, there is a surplus of about 3½ millions available for export, the greater part of which has already been marketed.

Although the past year has been one of the most difficult in the experience of the Czechoslovak sugar industry, the fact that not a single bankruptcy or insolvency took place is a tribute to its excellent organization and efficiency.

The 1923 Sugar Beet Prospects.—The Acting Commercial Secretary at Prague has informed the Department of Overseas Trade that according to official figures a considerable

increase in the area under beet cultivation in Czechoslovakia has taken place this year. This fact is of great importance to the sugar industry as, if the harvest is a favourable one, the sugar refineries will have at their disposal a considerably larger supply of beet than for many years past. The production will be more rational, and the costs of production, being divided up more uniformly, will be greatly reduced. All the Czechoslovak sugar factories have been established to handle large quantities of beet.

The prevailing crisis has been the cause of considerable difficulties to many factories, and several have been obliged temporarily to stop production. The situation during the war and during the years immediately following the Armistice, resulted in a decrease in the surface sown with beet. The home prices of cereals and other agricultural products being higher than those on the international market, farmers ceased to be interested in the cultivation of the beet, which demands greater care and more trouble. To-day, however, the position is quite different. Owing to the fluctuations on the international market, and to the consequent uncertainty of what prices cereals will fetch, farmers have turned their attention again to the intensive culture of the beet, the price of which has been guaranteed to them by the negotiations which have taken place between them and the sugar producers.

After many years of stagnation, the surface under beet cultivation this year shows an appreciable increase, as can be seen from the following figures:—

SURFACE UNDER BEET IN CZECHOSLOVAKIA

	1923 hectares.	1922 hectares.	Increase, per cent.
Bohemia	113,520	96,151	18·07
Moravia	68,490	59,889	14·36
Silesia	2,514	2,163	16·23
Slovakia	34,962	26,388	32·49
Total	219,486	184,591	18·90

The largest percentage increase is shown in Slovakia. This is explained by the fact that it was in Slovakia that the greatest reduction in beet-sowing took place. During the last pre-war campaign (1912-1913), the surface under beet amounted to 68,650 hectares, in 1919-1920 it had been reduced to 20,187 hectares, or scarcely one-third of the area sown in 1912-13. Taking Czechoslovakia as a whole, the increase over last year amounts to about one-fifth.

This year the sugar beet is well developed. Up to the end of June it suffered from lack of heat and sun, but if the hot weather which set in at the beginning of July continues, there is every hope that this year's beet harvest will be satisfactory.

Although it is too early yet to predict the prospects of the coming season, there is every indication that it will be a favourable one, provided two-thirds of the production are allowed to be exported as already agreed upon, and the Government gives the industry a free hand. In view of a probable increase in production, foreign buyers have already shown a great interest in the quantity of sugar likely to be available in Czechoslovakia

Czechoslovakia is, however, not the only country in which an increase in the area under beet cultivation has taken place. In other European countries, with the exception of Germany, the surface has also been increased, as can be seen from the following figures:—

Country.	1923 hectares.	1922 hectares.
Belgium	66,500	59,176
Denmark	30,000	24,330
Czechoslovakia	235,000	182,849
France	145,000	116,410
Holland	72,500	57,526
Italy	90,000	85,000
Hungary	35,000	28,775
Germany	337,000	360,441
Poland	150,000	170,825
Russia	230,000	175,000
Sweden	32,000	16,716
Other countries	145,000	113,402
Total	1,568,000	1,327,000

American Commerce Reports.[1]

Sugar Situation in Europe

With the exception of Germany, all sugar-producing countries in Europe have substantially exceeded last season's acreage. Sugar-beet plantings are reported 11·5 per cent. under last year in South Germany and 23·3 per cent. lower in the Rhineland. Late reports confirm the estimate that beet acreage for all Germany is between 5 and 6 per cent. lower than last year.

The deadlock between beet growers and sugar manufacturers in Sweden has been settled by conceding higher prices to the growers. The area planted to beets in Sweden will probably exceed that of last season by 200 per cent. The Swedish Government has suspended the sugar monopoly and price fixing, effective June 1st.

The Rumanian Government has prohibited the export of beetroot and its sugar derivatives. In Czechoslovakia, State regulation of sugar prices brought out hoarded stocks that had been withdrawn from consumption for a speculative rise. It is estimated that 60 per cent. of the sugar released for consumption in April and May was not placed on the market. At present, stocks in Czechoslovakia are much heavier than had been supposed.

Consumption in the principal sugar-using countries of Europe since September 1st, 1922, has been reported as 7·4 per cent. higher than for the same period last year and 37·8 per cent. higher than for the corresponding period of the sugar year 1920-21. The countries covered by this estimate are Germany, Czechoslovakia, France, Belgium, the Netherlands, and England —[*Commerce Report, Berlin, June, 1923.*]

Favourable Sugar Outlook in Argentina.

Official sources estimate that stocks of sugar together with the results of this year's grinding will provide a supply sufficient to meet the country's requirements up to December 31st, 1923. The stocks, visible and invisible, were placed at 42,585 metric tons on April 24th, 1923. The seasons grinding commenced in May.

During 1922 the total consumption of sugar was 257,704 metric tons, or approximately 21,500 metric tons per month. Should the 1923 grinding come up to expectations and yield about 250,000 metric tons, Argentina will not be forced to look to Brazil or the United States as a source of supply before January, 1924. Excellent weather and the increased sugar content of the Java cane, which has entirely replaced the native or "criollo" variety, are the two factors to which a larger yield can be attributed. There has been only a moderate increase in the acreage under cultivation.

During 1922, Argentina imported 29,310,300 kilos of refined sugar from Brazil, 22,845,186 kilos from the United States, 7,710,780 kilos from Uruguay, and smaller amounts from Germany, Cuba, and the Netherlands. Argentina is both an importer and exporter of sugar, according to the state of the market.—[*Trade Report, Buenos Ayres.*]

The Sugar Industry of Honduras.

Sugar cane has been grown in Honduras for many years. Modern methods of sugar manufacture were first introduced about 1910 at Cantarranas, in the southern part of the Republic. In 1914 another small mill was built at San Antonio del Oriente, also in the south. These mills are not in operation at present. The first really successful attempt to establish a sugar industry was made in 1914 at Monte Christo, in northern Honduras. In 1922 another mill was completed at La Lima in the Cortes district. These two mills are the only ones operating or projected at the present time, although an attempt is being made to put the Cantarranas mill in condition to operate in 1924.

The northern part of Honduras is better fitted for the growing of cane than the southern part. The land is better adapted to large agricultural operations, and transportation is better. In addition, it has been found that cane is an excellent crop for the

[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

exhausted banana lands of the north. Labour conditions in the sugar districts are very much like those on the banana plantations. Increasing numbers of labourers are coming from Salvador to the fruit and cane districts of Honduras. Part of these form permanent settlements, while large numbers return to Salvador for work on the coffee plantations during a part of the year. The coffee season in Salvador ends when the sugar cane harvest in Honduras begins.

Sugar production has increased from about 250 tons of granulated sugar in 1910 to 11,000 tons of granulated and 96° raw sugar in 1922. An outturn of 40,000 tons of sugar of all grades is estimated for 1923. Any increase in production in the immediate future will be of 96° raw sugar, at least until the installation of the necessary machinery for making granulated sugar. No estimate can be made of the amount of "dulce" produced throughout the Republic. This is a low-grade sugar made in open kettles. The several centres of this industry are sufficient to supply the domestic demand and serve to reduce to a great extent the consumption of higher-grade sugars.

Expansion of the industry to a production of 110,000 tons annually of all grades is contemplated. Apparently the limiting factors are labour and foreign markets.

Honduras exports sugar to the approximate value of $1,500,000 annually, the larger part going to Canada through the United States. Honduras also imports sugar to the approximate value of $55,000 annually, principally from Guatemala, Nicaragua, and the United States. Nearly all of the imported sugar goes to the southern coast of the country. Internal transportation conditions prevent the shipment of northern-grown sugar to southern points.

Publications Received.

Patents for Inventions. By J. Ewart Walker, B.A., Barrister-at-Law, and R. Bruce Foster, B.Sc., Barrister-at-Law. (Sir Isaac Pitman & Sons, Ltd., London, Melbourne, and New York.) 1922. Price: 21s. net.

Many books have been published for the guidance of the inventor through the intricacies of patent procedure, but none of which we have knowledge sets forth more clearly and more concisely the present practice and law of the subject than does the excellent volume before us. It is a carefully compiled, authoritative work, supplied with copious references to decided cases, and may be confidently recommended to inventors, firms, and companies interested in patents from the point of view of their protection and commercial exploitation. In the introduction a broad survey of the matter of letters patent is made, the various questions outlined there being more fully treated in the following chapters, starting with the steps an applicant must take, the formalities and requirements he must comply with, and the difficulties he may encounter prior to the grant of the patent. Then the construction of the complete specification as a legal document, the question of the validity of the patent, the right of the patentee, the methods by which he may enforce these rights, and finally the liabilities of the patentee, are successively discussed.

Light is thrown on many points upon which there is often some confusion of ideas on the part of inventors. "Subject matter," for example, is a term that is frequently loosely used. It is here pointed out that when a patent is said to be invalid for want of subject matter, this may mean that it lacks any one or more of the following essentials for a valid patent, namely: (1) A manner of manufacture which can be patented; (2) novelty; (3) utility; or (4) inventive ingenuity. But the term "subject matter" is often, and in fact most frequently, used to indicate the last essential, that is, inventive ingenuity, even to the exclusion of the others. In this book the above requirements are kept distinct, and where inventive ingenuity is meant, this term is used, and the more general but somewhat indefinite term "subject matter" is avoided.

Publications Received.

Report on Benzol-Alcohol Tests made by the London Omnibus Co., Ltd. Anon. (London General Omnibus Co., Ltd., Westminster, London, S.W. 1.)

Experiments (both bench and service tests) are described on the results obtainable with mixtures of benzol and alcohol in the proportions of 75 : 25, 95 : 5, 80 : 20, and 50 : 50; and briefly stated the conclusions arrived at were: (1) The greater the percentage of alcohol, the higher is the possible thermal efficient for the same compression; (2) the greater the percentage of alcohol, the higher can compression be raised with a consequent rise in the thermal efficiency; and (3) with high compression the ill effects of valve pockets is more noticeable at small throttle openings than with low compression. In the opinion of Messrs. D. E. BATTY and G. J. SHAVE, the engineers superintending the tests, the bench and road trials conducted proved the serviceability of fuels containing alcohol, and that in the fuel of the future alcohol should be the chief ingredient.

Beschrijving der te volgen Methoden van Onderzoek voor de Bedrijfscontrole in de Nederlandsche Beetwortelsuikerfabrieken. [Description of Methods of Analysis to be followed in the Chemical Control of Dutch Beet Sugar Factories.] Dr. C. L. Brunings, Dr. H. C. Prinsen Geerligs, and others. (Vereeniging van Beetwortel Suikerfabrikanten en Raffinadeurs, The Hague, Holland), 1923. Price: F 2·0.

This pamphlet contains details of the procedure to be followed in effecting chemical control in Dutch sugar factories, and has been compiled by a Committee consisting of Mr. P. J. H. VAN GINNEKEN (Chairman), Dr. BRUNINGS, Dr. PRINSEN GEERLIGS, and others. Preliminarily it describes the calibration of flasks, pipettes, etc., the testing of hydrometers, and the preparation of standard solutions, after which it prescribes the methods to be adopted for the sampling and chemical examination of the several products met in the manufacture of beet sugar from roots to final molasses, which methods are in general well-known and approved, and therefore call for no comment here.

The History and Present State of Scientific Research in the Dutch East Indies. (Koninklijke Akademie van Wetenschappen, Amsterdam.) 1923.

This is a series of pamphlets (in English) prepared by the Royal Academy of Science of Amsterdam to summarize the development of various fields of pure and applied science in Java, such as: geology, oceanography, meteorology, vulcanology, zoology, anthropology, and botany. There is also a very interesting pamphlet entitled "A Review of Chemical Investigations in the Dutch East Indies," which forms a very brief digest of the notable work that has been done by Dutch chemists engaged in the country mentioned in sugar cultivation and manufacture, and indigo, chincona, coffee, tea, rubber, tobacco, oil palm, rice and other industries.

Some Aspects of the Law of England affecting Chemists. Evan J. Macgillivray, Barrister-at-Law. (Institute of Chemistry, 30, Russell Square, London, W.C. 1.) 1923.

This is the report of a lecture delivered before the Institute of Chemistry recently, which dealt *inter alia* with the following points: The chemist's right to the title of chemist; the chemist's protection in respect of his discoveries; the chemist in relation to his contracts; and the chemist in relation to the safeguarding of industries.

The death is announced of Sir ROBERT PARK LYLE, head of Abram Lyle & Sons, Ltd. till its amalgamation with Henry Tate & Sons, Ltd. He was Chairman of the British Sugar Refiners Association and during the war was Chairman of the Royal Commission on Sugar Supplies, in which capacity he supervised the vast task of provisioning the United Kingdom and to some extent the Allies with the necessary sugar.

Brevities.

The Peck juice strainer[1] recently installed by the Hawaiian Commercial and Sugar Co. at Puunene, Maui, T.H., is stated to be giving satisfactory results by Mr. W. G. HALL, who remarks that "its success has been far above expectations; that there is nothing like it in simplicity and capacity; that it works in with the Dorr clarifier very well indeed; and that they are complementary to one another."

The death is announced of Mr. DUNCAN H. GIBB, a former refiner in Greenock, whose business was carried on under the name of D. & J. GIBB, at a refinery in West Burn Square, which was recently demolished to make room for Harland & Wolff's shipbuilding yard extension MR. GIBB was 76 years of age, and a native of Ayrshire. He was a notable sportsman, and owned a number of horses and followed the hounds

It has been decided by the Board of Supervisors that the Louisiana Experiment Station shall be moved from Audubon Park (where it has been located during the past 34 years) to the site of the Great Agricultural College a few miles below Baton Rouge. The Research Staff of the Station will be provided with particularly well equipped laboratories, and it is reported that sufficient money will also be available for the construction of a model factory in the same vicinity.

The Reparations Commission at Paris has had before it the question whether Germany is liable under the terms of the Treaty of Versailles to deliver sugar as part of the reparations in kind. France and Italy have demanded the delivery of sugar in reparation for sugar factories destroyed within the zone of fighting. Germany has replied that sugar does not come within the category of "materials and labour" referred to in the paragraph depended on, that is 19 *bis* of Annexe 2 of part 8 of the Treaty. The verdict of the Commission will be given later on.

FERDINAND KRIJZ[2] states that in the absence of a pycnometer, a 100 mm. polariscope tube (preferably one provided with the Landolt device) may very well be used for the determination of the specific gravity of liquids, solids, and semi-solids. This chemist states that the result thus obtained corresponds to the first three decimal places with that found by means of a pycnometer, values of 0·9357 and 0·9353 being obtained in polariscope tubes having capacities of 4·9 and 7·4 c.c. in the case of a sample of varnish, as compared with one of 0·9351 in a pycnometer with a ground glass stopper and a capacity of 20 c.c. Similarly comparable results are said to have been obtained with solid and semi-solid substances, e.g., ultramarine blue and slaked lime.

Mr. F. S. EARLE[3] points out that some confusion in regard to the identity of the D 116 and D 625 canes appears to have arisen in Porto Rico. Both are stout, vigorous, green canes with quite similar bud characteristics, but the D 116 is especially characterized by the broad, rather swollen, conspicuously brown growth rings at each joint, just above the bud. In the D 625, on the other hand, the growth ring is narrow, rather sharply constructed or sunken, and of the same green colour as the stalk. Then in this variety the margin of its leaf scar is siliate with stiff bristles, while in D 116 it is smooth. Moreover, it is added, the D 625 has more wax or bloom, the nodes are more constricted, and the foliage has more of a blue-green or glaucous green cast.

Regarding the derivation of the word "muscovado," NOËL DEERR[4] states that the best authorities derive it from the Spanish term *menoscabo*; which is made up of *menos*, little, and *acabar*, to finish, implying the idea of inferiority. Mr. ALFRED J. WATTS,[5] of Pernambuco, however, believes it to come from the words *mas*, more, and *cavado*, dug, suggesting a product that is obtained by being deeper dug, the reference being to the old practice of using very large wooden or burnt tile-clay sugar moulds, from which the clayed sugar had to be dug out, the apparatus being either too heavy or too fragile for its contents to be knocked out, or similarly discharged. In such a clayed sugar mould, the "brance" or white crystals would be on the top, the "somenos" (*de somenos valerer*, of less value) in the middle, and the *mas-cavado* in the bottom part. This derivation is said to have the support of certain old-time sugar manufacturers of Brazil, well versed in this branch of the art of Père LABAT.

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1 *I.S.J.*, 1921, 91, 155. 2 *Zeitsch. Zuckerind. Cechoslov. Republik*, 1922, 46, No. 39, 472.
3 *Facts about Sugar*, 1923, 16, No. 24, 498. Compare also Mr. Earle's paper on the sugar cane varieties of Porto Rico. *J. Dept. Agri. P. R.*, 5, 3, p. 105.
4 "Sugar Cane" By NOËL DEERR. Page 428. (NORMAN RODGER, London.)
5 *West India Committee Circular*, June 7th, 1923.

Review of Current Technical Literature.[1]

CHEMICAL CONTROL REPORT FOR THE 1922 CROP OF THE ONOMEA SUGAR CO., TERRITORY OF HAWAII. *Anon.* *Published by the Onemea Sugar Co., Papaikou, T. H.*

BALANCE: RECOVERY AND LOSSES.

	Tons Polarization. Entered Manufacture	Produced.
Entered into Manufacture :		
183,487·72 tons cane @ 12·176 per cent polarization	22,341·68	
Sugar due to crop 1921	158·12	
Marketable Sugars produced :		
21,081·13 tons @ 97·15 per cent. polarization		20,480·02
Estimated as available sugar in process of manufacture, 1922 ..		106·04
Loss in manufacture		1,913·74
	22,499·80	22,499 80

LOSSES

	Tons	Per Cent Polarization.	Per Cent Cane	Per Cent Polarization in Cane.	Tons Polarization
Bagasse	38,831·18..	0 698..	0·148..	1·213..	271·00
Press Cake	4,229·55..	0·285..	0 006..	0·054..	12·04
Molasses	4,504·91..	*32·376..	0·795..	6·528..	*1,458 52
Undetermined			0·094..	0·771..	172·18
Total Losses			1·043..	8·566..	1,913·74
Recovery			11·133..	91·434..	20,427 94
Polarization entering mill			12·176..	100·000..	22,341·68
Polarization lost at mill			0 148..	1·213..	271·00
Polarization entering boiling-house			12 028..	98·787..	22,070·68
Polarization lost in boiling-house per cent. polarization in mixed juice					7·4
Polarization recovered in boiling-house per cent polarization in mixed juice ...					92·60
Theoretical recovery of sucrose per cent sucrose in mixed juice					93 10

USE OF MOLASSES AS BOILER FUEL IN THE CANE SUGAR FACTORY. *J. Wyllie.* *Sugar News*, *1923*, *4*, *No 4*, *161-162*.

A boiler using molasses as fuel was installed at the factory of the Hawaiian-Philippine Co., Silay, Occidental Negros, P.I., and in the off-season steam from it was used for the machine, blacksmith, and carpenters' shops, for the ice plant, as well as for pumping water from the artesian wells for domestic and locomotive water supply. Steam from this unit was used in the factory during the grinding season when short of bagasse; and also for boiling out the evaporators during week-ends, thus allowing the bagasse boilers to shut down with the mill. Test runs carried out during two days (10 hours each) gave the following figures for the first day: Molasses burnt, lbs., 7,623; water evaporated in the boiler, lbs., 15,005; lbs. of water per lb. of molasses, 1·96; ash, lbs., 744·2; lbs. of ash per lb. of molasses, 0·097; temperature of boiler feed water, 180° F.; Brix of molasses, 86°; and potash in the ash, 25·66 per cent. This test shows about 2 lbs. of water per lb. of molasses, and in this molasses boiler unit only about 25 per cent. of the molasses made in the factory per day was consumed. If the factory were short of bagasse, and had a molasses boiler unit large enough to handle the daily output, approximately 165,657,000 B.T.U. of additional heat would thus be obtained. Assuming 36 tons of molasses are turned out per hour with a Brix of 86°, this amount would generate 144,000 lbs. of steam, which in quadruple effect could deal with 5 6,000 lbs. more water in 24 hours, allowing 432,000 lbs. for maceration, which is 13·5 per cent. for 1600 tons of mixed juice. About 5760 lbs. of ash, containing a certain amount of unburnt carbon, could be recovered per day from the molasses furnaces.

[1]

* True Sucrose.

DATA REGARDING THE GEVEKE FURROW DITCHER. *H. L. Geveke. Sugar News, 1923, 4, No. 4, 167-170.*

"After making exhaustive inquiries in Java, in order to find out by what methods maximum yields could be produced, I came to the conclusion that it is not sufficient to plough down to a depth of 8 in. (0·21 metre), but that the roots grow best in a carefully prepared subsoil, previously well loosened and broken. Java growers have experienced that the looser and finer the earth is around the roots, the quicker and easier cane grows. Perhaps it may not be possible to plough in heavy clay deeper than to a depth of 8 ins., either by means of oxen or by cable or tractor power. At all events, at such a depth this should meet with considerable difficulties. When ploughs are used to open up the ground, large lumps of earth are heaped on each side of the furrows, and this is especially true when the land is moist. It is evident that the earth cannot then be in good condition for planting, and it must then be broken up before the furrows are filled up again. The "Geveke" Furrow Ditcher, with which I have worked on Java sugar estates, prepares the furrows completely, ready for planting to a depth of 12 in., with the width of 18 in. As experience has shown that better results were obtained by still further breaking and loosening the earth before planting, the demand for these "ditchers" is constantly on the increase. My new "ditchers" are able to dig furrows to a depth of 18 in. and of the same width. The earth thus dug up is completely broken up and all weed roots destroyed. Superintendents of leading Java sugar estates who attended the demonstrations unanimously declared that the machine-dug furrows were faultless, and that they produced a soil for planting that was in a better condition than any hitherto prepared by manual labour or by ploughs. During these demonstrations, inquiries were made for a dozen of the writer's ditchers for next season."

EVALUATION OF DECOLORIZING CARBONS BY THE EQUAL WEIGHT AND THE EQUAL EFFECT PROCESSES.[1] *E. Spörry. Chemiker Zeitung, 1923, 47, 203-205.*

As an almost general rule in the testing of the comparative value of decolorizing carbons, equal weights of the samples are used for the treatment of an equal weight or volume of a liquid, e.g., raw sugar liquor, or molasses; and if it is found that one of the preparations takes out 75 per cent. of the colour originally present, and the other 50 per cent., then it is usually stated that the first carbon has a decolorizing power 50 per cent. greater than the second, in other words, that it is 50 per cent. better. On the other hand, instead of this "equal weight process," one may apply the "equal effect process" by ascertaining the amount of carbon necessary to reach a certain degree of decolorization, say the complete, or almost complete, elimination of the colour present. It certainly would appear more reasonable to employ the second method when testing the value of decolorizing carbons in the laboratory, since it more closely corresponds to the object in view in practice in the refinery or white sugar factory. It has, therefore, seemed of interest to the author to carry out a number of experiments based on the two different principles, in order to demonstrate to what extent the results obtained may differ one from another. Determinations were made with 5 well-known commercial preparations (here designated alphabetically) by heating them with 150 c.c. of a solution of beet molasses (containing 40 c.c. per litre) at 80-90°C. during 10 mins. while continually stirring. In the "equal weight process," using amounts of the carbons from 0·1 to 0·6 grm., and ascertaining the degree of decolorization effected by these, the following results were obtained, expressing the amount of colour removed (read in a Stammer colorimeter) as a percentage of that originally present in the untreated molasses solution:—

Amounts of Carbon used, grms.	Decolorization Effected by the Different Carbons. A	B	C	D	E
0·10	59	42	27	20	11
0·25	88	73	45	39	17
0 40	95	86	56	55	23
0·60	—	93	68	69	29

[1] Contribution from the laboratory of the Verein für Chemische und Metallurgische Produktion (the manufacturers of "Carboraffin").

On the other hand, in the "equal effect process" the amounts of the different carbons necessary to effect various degrees of decolorization were ascertained with the following results:—

Decolorization Effected, per cent.	A	B	C	D	E
	Amounts of the Various Carbons Necessary.				
20	0·03	0·04	0·06	0·10	0·32
40	0·06	0·09	0·20	0·25	1·00
60	0·10	0·16	0·46	0·46	1·90
80	0·18	0·32	0·85	0·82	—
90	0·28	0·49	1·21	1·26	—

Now, it is usual when examining a series of carbons like these to use one as the standard; and in the case of these results the preparations designated as *C* (of American manufacture) was selected, and the following tabulations were then made:—

Amounts of Carbon used. grms.	A	B	C	D	E
	Comparative Decolorizing Values, $C = 1·0$.				
0·10	2·2	1·6	1·0	0·7	0·4
0·20	2·0	1·6	1·0	0·9	0·4
0·40	1·7	1·5	1·0	1·0	0·4
0·60	—	1·4	1·0	1·0	0·4
Average	*2·0*	*1·5*	*1·0*	*0·9*	*0·4*

Decol'ation Effected, per cent.	A	B	C	D	E
	Comparative Decolorizing Values, $C = 1·0$.				
20	2·0	1·5	1·0	0·6	0·2
40	3·3	2·2	1 0	0·8	0 2
60	4 6	2·9	1·0	1·0	0 2
80	4·7	2·6	1·0	1·0	—
90	4·3	2·5	1·0	1·0	—
Average	*3·8*	*2·3*	*1 0*	*0·9*	*0·2*

Consideration of the results stated in the above tables show how the results differ according to the process applied, that is, whether equal weights be used (here called the "Old Method"), or whether equal effects be attained (the "New Method"), this being more clearly demonstrated by the following figures which give the average values obtained from the last two tables:—

Carbon.	Old Method.	New Method
A	2·0	3·8
B	1·5	2·3
C	1 0	1·0
D	0·9	0·9
E	0·4	0·2

It is concluded, therefore, that, since in practice one aims at reaching a certain decolorizing effect (it may be the complete, or almost complete removal of the colouring matters present in the liquor), it is the "equal effect process" that should always be used in the laboratory for expressing the relative values of these preparations.

Determination of Ash in Cuban Raw Sugar by Direct Incineration as Compared with Sulphating. *U. S. Jamison and Jas. R. Withrow. Journal of Industrial and Engineering Chemistry, 1923, 15, No. 4, 386–389.*

In the determination of ash in sugar products, the method in which the sample treated with sulphuric acid (either before or after carbonizing) is almost universal. It has always been understood that direct incineration gives results lower than the truth, owing to the volatilization of certain mineral constituents, and many workers (Landolt,[1] for

[1] *J. prakt. Chem.*, 1868, 103, 29.

example) have produced figures showing a marked decrease in the weight of ash on continued heating. Working with a 96° Cuban raw sugar, the authors however state that in using direct incineration they have never found any difficulty in obtaining a constant weight, and they quote figures to this effect. Further, this method is considered to be simpler and more rapid than that involving sulphating, and is therefore recommended as preferable. Various modifications of the direct incineration method have been proposed from time to time, in which oxalic or benzoic acid, zinc oxide, sand, vaseline, are incorporated with the sample previous to ignition, for the purpose of hastening the ignition or preventing foaming; but none of these was shown to afford any marked advantage. It was found that the best means of preventing foaming over in the direct incineration method is previously to heat the crucible containing 2-5 grs. of the sample on a hot plate until carbonized, under which conditions carbonization starts locally at the bottom of the crucible and not throughout the whole mass, as often occurs when the crucible and its contents are heated right away to a high temperature. In regard to the sulphating method, this is considered to have no advantage over direct incineration (other than that of increasing the weight of the ash), whilst it demands a somewhat longer time to effect complete incineration. In using this method, the procedure was to treat 2–5 grs. of the sugar in platinum or porcelain crucibles with 2 c.c. of diluted sulphuric acid (2 parts of acid and 1 of water), heat on the hot plate till completely carbonized, igniting in the muffle to white ash, cooling, re-treating with 3 or 4 drops of the diluted sulphuric acid, heating to low red heat for 15 mins., cooling, and weighing. In place of the factor of 0·9 for converting the ash found by sulphating to that given by direct incineration (or by the process of carbonizing and leaching, which is stated to give the same result), one of 0·66 was found applicable. This means that instead of a deduction of 10 per cent, one of 33·25 per cent. is necessary; and the sulphated ash as actually obtained (that is, before making the usual 10 per cent. deduction) is really 49·80 per cent. higher than the direct incineration result. A number of experiments were made with porcelain crucibles, as compared with platinum ones, and practically identical results were obtained in both the direct incineration and the sulphating methods.

Ash of Sugar Products, its Determination, its Influence on the Polarization, and its Effect on the Combustibility of Sugar. *C. A. Browne and C. A. Gamble.* *Paper read before the Sugar Division, American Chemical Society, New Haven Meeting, April, 1923.*

Direct incineration for the determination of the ash was shown to be unreliable, owing to the loss of chlorine, sulphur, and other constituents, and a plea was made for the direct determination in sugar products of chlorides, sulphates, nitrates, ammonium compounds and other constituents which are affected by the incineration. The influence of the variation of the mineral constituents of juice in decreasing the polarization and purity, and in increasing the amount of molasses, was demonstrated by quoting the results of analyses from different factories grinding cane from soils of high and low salt content. Ratios of the soluble and insoluble ash of raw cane sugars were given, this figure being found to vary from 50:1 to 1:7. Also the effect of ash on the combustibility of sugar was mentioned; and the bearing of the results for the ash and chlorine contents upon the problem of determining the damage to sugars by wetting with salt water was discussed.

Tare Room Polariscope (Saccharimeter) for Use in Beet Sugar Factories. *Frederick R. Bachler.* *Paper read before the Sugar Division, American Chemical Society, New Haven Meeting, April, 1923.*

A new polariscope for use in the tare-room of the Oxnard factory of the American Beet Sugar Co. was constructed by Schmidt & Haensch to the specification of the author. Its special feature consists of a Lummer-Brodhun prism cube with attached telescope, centred in the optical axis of the polariscope between the analyser and the usual axial telescope. It is mentioned that the instrument permits a second observer to set the field

independent of the first observer, so as to observe the field while his colleague is setting it. Also that an auxiliary scale, greatly enlarged, permits the second observer to check the percentage reading indicated by the first.

INVESTIGATION OF THE CONSTITUENT TO WHICH THE DECOLORIZING POWER OF BONEBLACK (ANIMAL CHARCOAL) MAY BE DUE; AND THE NITROGEN CONTENT OF VARIOUS DECOLORIZING CARBONS. *Paul M. Horton.*[1] *Journal of Industrial and Engineering Chemistry, 1923, 15, No. 5, 519-520.*

T. L. PATTERSON[2] 20 years ago, isolated from animal charcoal an organic nitrogenous constituent of a gelatinous nature, which he claimed was mainly responsible for the decolorizing action, since it appeared to be 16 to 40 times more active than the material from which it had been isolated. His method was to extract the char with concentrated sulphuric acid, dilute the extract, and separate the brown, acid suspension, this being assumed to be the active constituent. However, TANNER[3] has pointed out that the addition of acid alone to a solution of molasses or of caramel will diminish its intensity of colour, and his view is that the acid held by Patterson's colloidal suspension caused the decolorization observed, and not the nitrogenous precipitate itself, since this when dry was observed to possess practically no decolorizing power. In this paper Mr. HORTON comes to the same conclusion as the result of two experiments. He extracted boneblack with concentrated sulphuric acid, in one experiment for one hour at 100° C., and in the other for three days at room temperature, both extracts being subsequently passed through a Pukal filter, diluted with five times their volume of water, the precipitates washed by decantation, the suspensions dialysed, the purified extracts made up to 1 litre with diluted water, and 50 c.c. of each (representing 1 grm. of the boneblack) evaporated to dryness, and kept at 110° C. until their weights were constant. These two residues were then taken up with water, made up to 50 c.c., and the decolorizing activity of the two solutions was tested by heating each with 50 c.c. of a solution containing 10 grms. of caramel per litre, "buffered" according to the method of TURRENTINE and TANNER,[4] filtering, and comparing the degree of colour with that of the original buffered caramel solution. No decolorizing power whatever was shown by either extract. It, therefore, seems proved that the decolorizing power of animal charcoal is not due to Patterson's extract, and there does not appear to be any reason for supposing it is due to any nitrogenous constituent. Early workers, such as WALLACE[5] supposed this to be so, since as the activity of char decreases so at the same time does its nitrogen content. That at any rate the activity of a decolorizing carbon is not correlated with its nitrogen content is shown by the analysis of various commercial preparations, such as "Norit," "Darco," and "Carbrox." Thus, in the case of "Kelpchar" and purified bonechar, their nitrogen content is about 2·0 per cent., but their activity is only about half that of "Norit" or "Darco," which contain 0·14 and 0·27 per cent. of the constituent in question, respectively. In conclusion, the author suggests that boneblack owes its power of removing colour to the presence of active carbon, and that the nitrogenous substance present serves as a reserve to supply fresh carbon on re-ignition, which, according to him explains why the char can be renewed by ignition only as long as it contains nitrogenous material. This does not preclude the possibility, however, that protein matter may have an important influence on the form assumed by the carbon on ignition. Activity of bonechar or carbon from any source is due to the same form of amorphous carbon, produced by the low temperature decomposition of vegetable or animal substances; but usually the surface of the carbon is coated over by a layer of hydrocarbons or of ash, the removal of which may be accomplished in the case of vegetable carbons by selective oxidation, and in that of bonechar evidently by solution in water or dilute acids.

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[1] Of the Audubon Sugar School, Baton Rouge, La. [2] *J. Soc. Chem. Ind.*, 1903, **22**, 608.
[3] *I.S.J.*, **1922**, 475.
[4] *Jl. Ind. Eng. Chem.*, **1922**, **14**, 19. [5] *Proc. Glasgow Phil. Soc.*, 1865, **6**, 377.

INFLUENCE OF VARIOUS CONDITIONS ON THE YIELD IN THE AFFINING OF RAW BEET SUGAR. *Joseph Roubinek.* *Zeitsch. Zuckerind. Cechoslov. Republik, 1923, 47 (iv), No. 27, 365-372.*

In general this procedure was to pug raw beet sugar of good quality with a saturated syrup at 73·5° Brix and 84·35° purity, using the proportions 66 and 34 parts by weight respectively; to swing out; and to wash off the remaining molasses with water, applying about 5 per cent. by weight of the sugar worked. Several conditions were studied. In regard to the temperature of the syrup used for pugging, whether 45, 60, or 80° C., this was found to exert little influence on the yield of affined white crystals, any fine grain which might be present being only partly dissolved at the highest temperature used. On the other hand, the volume of water used for covering was certainly important (as indeed one would expect), and when the amount applied was 4·78, 7·19 and 9·30 per cent. by weight, calculated on the raw sugar operated upon, the corresponding yields were found to be 81·47, 77·00 and 73·1 per cent., also stated on the quantity of raw sugar introduced. These figures are only about 1 per cent. lower than those summarized in the following table by LANGEN,[1] who stated that for washing good raw beet about 7–8 per cent. of water by weight on the raw sugar suffices, but that 10 per cent. is required in the case of inferior products.

Water for Washing, Per Cent.	Yield of Affinade, Per Cent.	Quotient of Purity of Run-off Molasses	Amount of Syrup in cub. m., per cent. of Raw Sugar used.
2	89·85	70·5	0·9
3	87·25	77·0	1·2
4	85·70	81·0	1·3
5	83·60	83·5	1·6
6	81·50	85·6	1·8
7	79·40	87·2	2·0
8	77·30	88·5	2·3
9	75·30	89·5	2·5
10	73·20	90 4	2·7

Then experiments were carried out to determine the influence of using syrups at 72 5, 68·2 and 66·7° Brix for the pugging operation; and it was shown quite conclusively that the optimum density is about 73° Brix, and that if a concentration much less than this be used the result is a low yield, other conditions being the same. While operating these tests, the procedure followed at first was to swing out, then apply the water; but it is stated that when this was done the product had a purity less than 99·0°, and was yellowish, though probably the nature of the raw sugar worked had much to do with this result. Good "affinade" of 99·5° purity was obtained only when the water was injected immediately after the charging of the machine with the pugged mass, and it would seem that the viscous molasses penetrated the layer of crystals lying against the drum only after it had been diluted with the water. Lastly, some experiments were made to ascertain how long the washed crystals should be swung after finishing the application of the water; and the result reported under this heading was that this "after-drying" should last about 3 min. in order to reduce the water content of the affined crystals to 2 or 2·5 per cent.

FACTORS GOVERNING SUCCESS IN JAM AND JELLY MANUFACTURE. *H. A. Noyes.* *Industrial and Engineering Chemistry (News Edition), March 10th, 1923, page 3.*

In a paper read before the Michigan Agricultural College section of the American Chemical Society on February 6th last, the author gave the following summary of important points observed in the study of the relationship of pectin, sugar, and acid, and methods of boiling these, in the manufacture of jam and jelly:—(1) Too much sugar is usually used in the open kettle method of cooking. (2) Boiling in an open kettle at atmospheric pressure destroys the pectin as far as its jelly-producing power is concerned

[1] *Centr. Zuckerind.*, 1909–10, 18, 67.

and destroys natural fruit flavours and produces undesirable ones. A series of open "cooks" made to test out this point (using a pectin preparation extracted and concentrated with minimum heat) showed in many cases a loss of one-half the pectin. Proper methods would have given almost double the quantity of jelly from the same amount of pectin. (3) Vacuum cooking increased the quality of the product, made larger quantities of jelly and jam from the same amount of raw materials, and yielded a product which kept well in storage. (4) Jellies were produced with as low as 0·25 per cent. pectin (calculated to finished jelly), and with as high as 1·4 per cent. pectin in the vacuum and the one-minute cook processes. (5) Jellies were produced having as low as 38 per cent. sugar, and as high as 72 per cent. sugar in the vacuum and the one-minute cook processes. (6) Jellies were made having as low as 0·60 per cent. acid, as tartaric (calculated to basis of finished jelly), and with as high as 3·0 by the vacuum and the one-minute cook processes. (7) The commercial production of jams and jellies by methods involving the proper proportions of pectin, acid and sugar for the particular fruits, and minimum heating will give, not only better products, but enough additional product to pay for the major expenses of labour now employed.

Use of Herzfeld's Invert Sugar Tables in Connexion with Bruhn's Iodine and Thiocyanate Volumetric Method of Determining Reducing Sugars. *G. Bruhns.* *Zeitsch. Zuckerind. cechoslov. Republik.* 1923, 47, No. 28, 373-378.

A correspondent has enquired of Dr. Bruhns whether one can utilize Herzfeld's tables to arrive at the percentage of invert sugar corresponding to the mgrms. of copper reduced when applying Bruhn's iodine and thiocyanate volumetric method, a full description of which has already been given in these columns.[1] Herzfeld's table was compiled from determinations made with 50 c.c. of Fehling's solution and 50 c.c. of sugar solution; whereas in Bruhn's procedure only 20 c.c. of Fehling's solution and 20 c.c. of sugar solution are used, that is 100 c.c. of liquid as compared with only 40 c.c., the question posed being whether it is permissible to multiply the amount of reduced copper found by Bruhn's method by 2·5 to convert the figure to the basis of Herzfeld's table. At first sight this method of calculation would not appear to be in order, as it would hardly seem likely that the amounts of reduced copper would be in the proportion of 1 to 2·5, seeing that the time of heating in the two cases is probably different. Nevertheless, it is now explained that, in spite of the volume being 100 c.c. in one case and 40 c.c. in the other, the results obtained by the two methods are by chance practically proportional, probably owing mainly to the fact that different methods of heating are employed. In Bruhn's method the flask is placed on wire gauze provided with a circle of compressed asbestos 60 mm. ($2\frac{3}{8}$ in.) in diam., and its contents heated to boiling point, ebullition being continued for exactly 2 min. with the smallest possible size of bunsen flame. On the other hand, a different method of heating was employed in obtaining the results for Herzfeld's table, and it so happens that the two methods of heating yield amounts of reduced copper in the proportion of 1 to 2·5. Therefore, by example, if in Bruhn's method it was found that the titre of 20 c.c. of Fehling's solution before reduction was 19·8 c.c. of the thiosulphate solution, and if it was 7·3 c.c. after reduction, the difference (12·5 c.c.) would give the number of c.c. of thiosulphate solution equivalent to the reduced copper. Since 1 c.c. of the thiosulphate solution = 8·8 c.c. of Cu, then 12·5 × 8·8 × 2·5 = 275 mgrms. of Cu, and this when read from Herzfeld's table is equivalent to 1·27 per cent. of invert sugar, if 20 c.c. of a solution containing 4 grms. of the sample have been taken for the analysis, or to 2·68 per cent., if only 2 grms. was the amount present. Furthermore, it is stated that this method of multiplying up with 2·5 enables one to read the result directly from Baumann's table when 2 grms. of sugar are present in the 20 c.c. of assay solution, or from Schrefeld's table when only 1 grm. is the quantity present. That this is so, is shown by a tabulation.

J. P. O.

[1] *I.S.J.*, 1922, 272.

Review of Recent Patents.[1]

UNITED KINGDOM.

MACHINE FOR EARTHING OR TUMPING-UP SUGAR CANE. *Joan J. M. Elias*, of Banjoemas, Java. *197,610*. October 13th, 1922. (Two figures; three claims.)

A machine for earthing or tumping up soil (one of a series of inventions by the patentee having for their object the performance of cane cultivation in an entirely mechanical way) is mounted on a motor carriage frame *1* of U-iron which is driven by the motor in any known manner as is shown schematically in dotted lines in Fig. 1. Behind the seat of the driver of the carriage, two bearings *2* and *3* are mounted, one behind the other, on the carriage frame. In the fore-bearing *2*, is adjustably guided in the vertical direction a frame carrying a left and right coulter or shares *7*, this frame comprising a horizontal bar *4*, which can slide upward and downward in the bearing *2*, and two vertical side-bars *5*, guided in boxes *6* fixed to the carriage frame and supporting also the bearing *2*. The two coulters or shares *7* are right and left hand respectively. They serve to loosen or to break up the ground at both sides of the cane-clods and throw the loosened ground up against the same. As the tillering of the cane does not exceed 26 cm. (approx. 10 in.) in diameter the shortest distance between the two coulters *7* is about 26 cm. (approx. 10 in.). By adjusting the depth-position of the two coulters *7*, the amount of earth that is thrown up can be regulated. This adjustment is performed by rotating a hand-wheel *9*, which is fixed at the top of a screw-spindle *8* to which the frame, *4*, *5* is fixed. The earth thrown up by the coulters against the cane-clods must be pressed down tightly by massive iron rolls *10* which are arranged behind the coulters *7*. These rolls which are the shape of a truncated cone, press the thrown up soil aslant against the cane-clods so that long ridgy walls are formed (as is usual) from which the cane arises. The rolls *10* are mounted on shafts carried by a frame which is adjustably mounted in the hind-bearing *3*, which frame comprises a horizontal bar *13* and two vertical side-bars *11*, from which the roll-shafts extend sideways, and which side-bars are guided in boxes *12* fixed to the carriage frame and supporting at the same time the bearing *3*. The depth-position of the two rolls *10* is adjustable, since the horizontal frame-bar *13*, guided in the bearing *3*, is suspended on a screw-spindle *14* provided at the top with a hand-wheel *15*. The wheel shafts of the carriage are made in the form of a yoke with downwardly bent vertical side-pieces and with horizontal connecting middle-pieces at a height of at least 125 cm. (50 in.) above the ground in order not to touch the tops of the sugar-cane plants. The seat of the driver of the carriage is at the fore-end, whilst the operator of the coulters and rolls has his stand between the two bearings *2* and *3*.

Fig. 1.

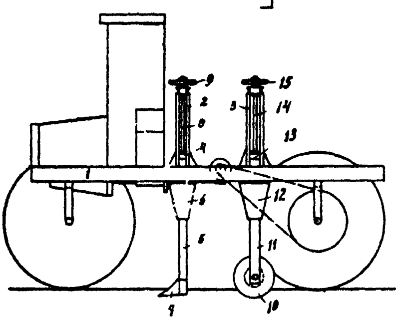
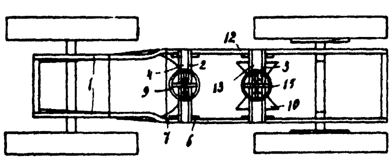


Fig. 2.



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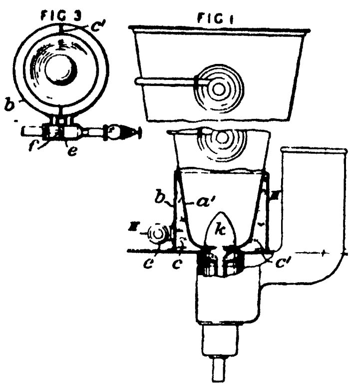
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Extraction of Juice from the Beet by Diffusion. *Sir John I. Thornycroft*, of Bembridge, Isle of Wight. *195,462.* January 3rd, 1922. (Four drawings; four claims.)

This invention has reference to that kind of apparatus suitable for the extraction of juice from vegetable or other substances, wherein the substance, for instance sliced beet, to be treated, is forced past a valve into the lower end of a vertical vessel (hereinafter called the diffuser), wherein it is subjected to the action of a liquid for the extraction of juice therefrom, the spent material being ultimately discharged from the top of the diffuser. Apparatus of this kind is described in the Specifications of former Letters Patent, Nos. 120,448[1] and 166,993[2] and the present invention may advantageously be applied in connexion with such apparatus. Referring to the drawing *a'* is the vertical diffuser made of gradually increasing cross sectional area in an upward direction, that is to say, of inverted truncated shape. Thus a smooth gradually expanding conduit is provided for the rising mass of material under treatment, thereby diminishing friction between the wall of the diffuser and the said material, and avoiding any liability of the material becoming jammed in the diffuser. The gradually increasing diameter affords more space for the material near the top of the diffuser, so that, for a given internal capacity of the diffuser, the total height of the diffuser can be reduced, as compared with a diffuser of the usual cylindrical shape. This reduction in the height of the diffuser, diminishes the pressure to be overcome when forcing fresh material into the lower portion of the diffuser, thereby effecting a saving in the power necessary for working the apparatus. A further advantage of the new construction of diffuser is that in some cases, the use of a screw conveyor for supporting and feeding the material through the diffuser, as described in the said former Specification No. 166,993, can be dispensed with, thereby simplifying the construction and reducing the cost of working of the apparatus. To enable the conical filter *a'* forming the lower end of a diffuser in apparatus of the kind herein referred to, to be readily cleaned, the casing *b* surrounding the filter and forming therewith a juice collecting chamber which may also serve, as in the example shown, for supporting the upper portion of the diffuser is divided vertically by vertical partitions *c* and *c'* so as to form two separate compartments that are connected to the opposite ends of a cylinder *e* that is fitted with a piston *f* and provided with an outlet controlled by a valve. The arrangement is such that normally the piston *f* occupies an inoperative position at the left hand end of the cylinder in Fig. 3, so that when the outlet valve is open, juice entering the two compartments through the filter *a'* can be run off through the outlet, and that by closing the outlet valve and reciprocating the piston *f*, juice entering the cylinder from the compartments will be forced first through one compartment and the corresponding portion of the filter *a'* and then through the other compartment and the other portion of the filter, so as thereby effectually to clean the filter. Apparatus according to the invention may as shown be provided with a feed chute, a feed cylinder, and a lift valve *k*, constructed, arranged and adapted for use substantially in the manner described in either of the said former specifications. The lift valve *k* may conveniently be made, as shown, of approximately ovoidal shape the larger portion being lowermost and having its smooth curved surface merged into that of the valve stem, so as to allow of a steady expansion of the stream of material fed into the lower end of the diffuser *a'* from the point where it first enters the lower end of the diffuser.



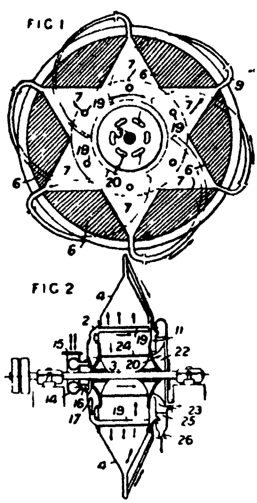
[1] *I.S.J.*, 1919, 146 [2] *I.S.J.*, 1922, 52.

COLLOIDAL MANURE. *Plauson's (Parent Co.), Ltd.*, 17, Waterloo Place, Pall Mall, London, S.W. *195,656*. June 28th, 1922.

Phosphates, feldspar and other raw materials are rendered colloidal for use as fertilizers by high-speed mechanical disintegration in the presence of a large quantity of water and a soluble silicate such as water-glass. A small quantity of free alkali or substances, such as carbonates or sulphides, having an alkaline reaction may also be present. The product may be concentrated as described in Specification 156,124, or by means of the filter-press described in Specification 181,023. A disintegrator which employs very heavy pressure as described in Specification 155,836 may be used. Organic colloids, such as sulphite cellulose liquors, tanning-agents, proteins or gums, may be added with the water-glass.

CENTRIFUGAL SEPARATOR FOR COLLOIDAL LIQUIDS. *Société Générale d'Evaporation Procédés Prache & Bouillon*, of Paris, France. *190,707*. December 6th, 1922, convention date (France), December 20th, 1921.

Centrifugal force has long been employed for separating solid matter held in suspension in liquids whose separation by filtration would be difficult to effect by reason of the fineness of the particles to be retained or of their colloidal nature. In the apparatus designed for this purpose, and described in the present specification, the liquid to be clarified is continuously introduced at the periphery of a cylindrical or other container, and at the base of a certain number of juxtaposed containers of pyramidal, conical or similar shape, which form an outwardly extending prolongation of the said cylindrical container, while fluid continuously passes out at the axis of the apparatus owing to the fact that the quantity of liquid to be clarified is always introduced into the apparatus in excess of that which can pass out at the periphery of the apparatus. Suitable means may also be provided for regulating the quantity of liquid passing out of the periphery. Referring to the drawings a machine is shown having end discs *2* keyed to the spindle *3* and connected together by two conical frustra *4* with axes coinciding with those of the discs. The space between the frustra *4* contains equally spaced blocks *6*, thus making a number of pyramidal spaces *7*. Tubes *9* connected to the vertices of these spaces are turned inwards towards the spindle as shown and terminate in conical reducing nozzles *11* to discharge into a collecting ring *25* with a discharge tube *26*. A second outlet is provided near the axis by apertures *20* in the end disc leading to the collector *22* and discharge tube *23*. The liquid is supplied through the tube *15* and passes through the distributor *14* and nozzles *16* into the casing *17*. It is then led into the perforated tubes *19* and the thick liquid with the solids passes to the periphery, the liquid passing through the tubes *9* to the discharge tube *26*. The clarified liquid passes from the tubes *19* towards the axis, through the perforated tube *24* to the apertures *20* and discharge tube *23*.



REMOVAL OF FROTH OF BOILING OR FERMENTING LIQUIDS. *Verein der Spiritus-Fabrikanten*, of Seestrasse, Berlin. *155,290*. December 15th, 1920. (Two figures; three claims.)

Claim is made for a method of, and apparatus for, removing the froth from boiling or fermenting liquids, consisting in utilizing fluid under pressure in conjunction with a nozzle arrangement to suck up the froth from the liquid and to project it against the walls of a casing, whence the resulting liquids may be returned to the main fermenting or boiling vessel, or conducted away.

Patents.

UNITED STATES.

ROTARY DRUM FILTER. *Godfrey Engel, Sr.* (assignor to *Buffalo Foundry and Machine Co.,* of Buffalo, New York, U.S.A.). *1,453,311.* May 1st, 1923. (Eight claims.)

Claim *5.*—In a filter, a rotating drum screen, means for feeding the liquid to be filtered into said drum, means for collecting the filtrate issuing from the drum, a suction nozzle disposed with its mouth adjacent the inner surface of the screen and at a point above the possible liquid level in the drum, a filtrate-collecting nozzle disposed with its mouth adjacent the outer surface of the screen and at a point to operate on the screen in advance of the first-mentioned suction nozzle, and means for directing a cleaning blast inwardly through the screen and disposed to operate on the screen after the screen has been acted upon by the first-mentioned suction nozzle.

PREPARATION OF ETHYL ALCOHOL FROM GALACTOSE. *Earl C. Sherrard,* of Madison, Wis., U.S.A. *1,454,521.* May 8th, 1923. (Dedicated by mesne assignments to the people of the United States.) (Three claims.)

Claim is made for the process of making ethyl alcohol which comprises subjecting galactan-containing material to acid hydrolysis, forming a solution of the product, and adjusting the acidity of this solution to not more than 50° during fermentation.

DEHYDRATION OF ALCOHOL. *Hyym E. Buc,* of Roselle, N.J. (assignor to *Standard Development Co.,* of Delaware, U.S.A). *1,455,072.* May 15th, 1923. (Five claims.)

Alcohol is dehydrated by mixing it with 20 to 50 per cent. of kerosene, heating the mixture with lime, distilling, and separately condensing the dehydrated alcohol.

RETORT OR KILN FOR THE TREATMENT OF CARBONACEOUS MATERIALS. *Fred. D. Marshall,* of Westminster, England *1,456,392.* May 22nd, 1923. (Thirteen claims.)

Claim 1.—A retort for drying, roasting, calcining or distilling carbonaceous or other materials, comprising a plurality of baffles or shelves disposed around the interior of a rotating cylinder or retort chamber, one end of said shelf being attached to the inner face of the retort chamber and the other end projecting inwards towards the interior, the arrangement around the periphery of the several shelves of each row being such that each shelf is disposed approximately along a chord of the retort chamber so as to deposit or shower the material raised by one shelf upon the surface of the shelf immediately in advance of it, at a point well beyond a vertical plane through the axis of the retort.

CARS FOR CARRYING CANE. *Harry T. Anderson,* of Butler, Pa. (assignor to *Standard Steel Car Co.,* of Pittsburgh, Pa., U.S.A.) *1,380,176.* May 31st, 1921.

A car constructed in accordance with the invention is shown in the drawings, in which Fig. 1 is a side elevational view, Fig 2 is a vertical cross sectional view taken on the line 2—2 of Fig. 1 ; Fig. 3 is a horizontal view of one of the transoms of the car ; and Fig 4 is an enlarged fragmentary section showing one of the side posts of Fig. 3 with the partition boards in place The car shown comprises the usual side sills *2*, centre sill *3*, body bolster *4*, swinging doors *5*, and door operating mechanism *6* ; and the body of the car is made up of vertical angle bars 7, bolted to the side sills *2*, and to angle bars *8* at the top of the sides and ends of the car. These parts are of ordinary construction, the invention being concerned particularly with the construction of the partitions *10* which divide the car into three compartments, usually 12 ft. in length. Each of the partitions *10* consists of a double sheathing of planks *11* laid horizontally with their ends bolted to side posts, the construction of which is best shown in Figs. 3 and 4. Each of these side posts consists of two Z bars *12* placed back to back, with their corresponding flanges *13*

in contact. Planks *11* are placed against these flanges *13* and are fastened in place by means of bolts *14*, which pass through both planks and both flanges. The bolts are preferably countersunk, as shown at *15*, so that the total thickness of the partition consists only of the combined thickness of the two planks and the two flanges *13* of the side posts

FIG. 1

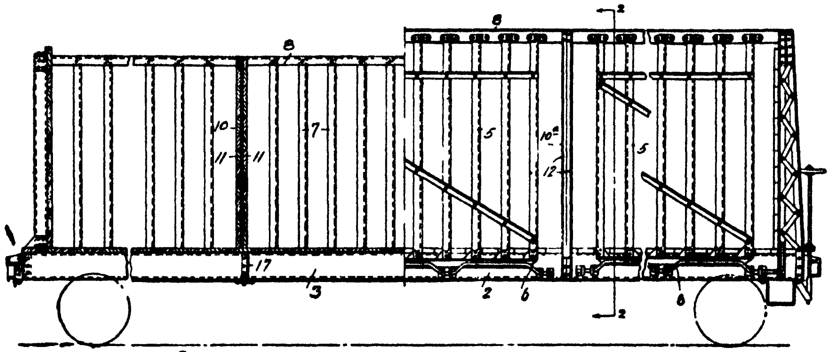


FIG. 2

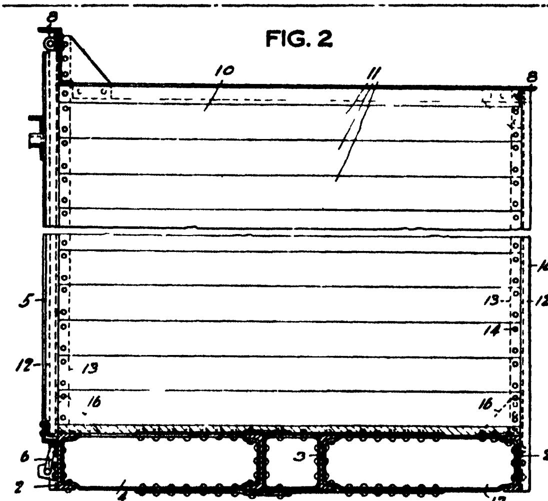


FIG. 3

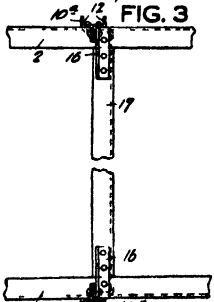
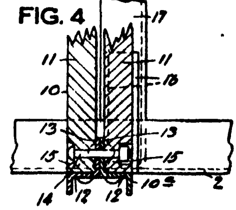


FIG. 4



This construction provides convenient means for connecting the side posts *10a* to the frame of the car by means of gusset plates *16* which, as shown in Figs. 2, 3 and 4, are rivetted to the transoms *17* and to the flanges *13*. This invention is an improvement over the partition construction in which the side posts are made up of channel bars. Where

the ordinary channel construction is used, a 4 in. channel bar is the minimum size that can be practically employed. This, with the use of 1½ in. planks, makes the total thickness of the partition 7 in. Where a 6 in. channel is used, the total thickness of the partition is 9 in. In this improved construction the combined thickness of the two planks and the two flanges of the Z bars is 3½ ins., thus making a reduction of 3½ ins. in comparison with the channel construction where 4 in. channels are used, and a reduction of 5½ ins. in comparison with the channel construction in which 6 in. channels are used. In addition to the saving in space produced in this invention, the strength of the side posts without increasing their weight is also greatly increased. It will also be observed that the partition planks *11* are fastened to the side posts by one half the number of bolts that are required in the channel construction. When the planks are bolted to channel bars, each plank is separately bolted to one flange of the side post, two bolts being required at each end of each plank. With the improved construction each plank is also fastened with two bolts, but the bolts also serve to attach the plank on the opposite side of the flanges *13*, as shown in Fig. 4. Thus the time and cost of assembling the partitions is greatly reduced.

INCREASING THE POWER OF DECOLORIZING CARBON BY INCORPORATING WITH IT A COLLOIDAL SOLUTION. *Leonard Wickenden,* of Flushing, New York. *1,447,452.* March 6th, 1923. (No drawings; eleven claims.)

Porous carbonized material, such as the carbon obtained by the evaporation and incineration of the waste liquors from wood pulp manufacture, is incorporated with suitable colloidal inorganic matter, such as colloidal solutions of iron, aluminium, or magnesium, and in some cases the combined product may be dried for transport without destroying its decolorizing power. An illustrative way of effecting this combination of co-operating colloidal material is to incorporate the porous decolorizing carbon therewith under suitable conditions of heat; and when granulated or relatively finely divided porous carbonized decolorizing matter of this character is boiled or heated with a 2 per cent. colloidal solution of aluminium hydroxide, for instance, a considerable amount of this colloidal material is adsorbed or incorporated with the carbon. This composite colloidal decolorizing material may be removed from the solution and drained, and if desired dried at about 100°C. or so, which does not destroy or seriously impair its decolorizing action. The incorporation of such colloidal material increases by several times the decolorizing power of the material on a test sugar solution. The colloidal solution of ferric hydrate may be similarly incorporated with such porous decolorizing carbon or other suitable material, such, for instance, as kieselguhr, fuller's earth, or other generally similar infusorial earths, which in some cases have some decolorizing action in themselves aside from their function in acting as supports or carriers for this incorporated colloidal material. A water solution of colloidal ferric hydrate having a strength of 3 to 5 per cent. more or less may while heated have such decolorizing carbon which has been heated to redness plunged into the solution and stirred or agitated therein for ten to twenty minutes or so, after which the carbon may be filtered out and dried at about 100°C., which in this case also does not destroy the added decolorizing action of the incorporated colloidal material, apparently because of the protective action of the colloidal or other special form of carbon present.

CONCENTRATED FERTILIZER. *Wm. Hazen and Wm. H. Ross,* of Washington, D.C., U.S.A. *1,456,850.* May 29th, 1923.

Claim is made for a process for the preparation of a concentrated material containing the three essential constituents of fertilizers, which consists in treating potassium chloride, with an excess of concentrated phosphoric acid, heating the solution to drive off hydrochloric acid, diluting with water, neutralizing the excess of acid with ammonia, and separating the precipitated salts from the mother-liquor.

BEET LOADER. *Johnston T. Hough,* of Denver, Colo., U.S.A. *1,455,914.* May 22nd, 1923. (Eight claims.). BEET PULLER. *Charles E. White,* of Moline, Ill., U.S.A. *1,451,725.* April 17th, 1923. (Nine claims.).

GERMANY.

Production of White Direct Consumption Sugar, using Aluminium Sulphate in Clarification. *Emil Barnert*, of Vienna, Austria. *364,424*. September 23rd, 1919.

In the ordinary methods of clarification, protein and other non-sugar substances are decomposed, and products which increase the amount of molasses are formed; but this disadvantage is avoided in the present invention, while at the same time such a clarification is effected that a direct consumption sugar is obtained without washing or covering with steam. Raw juice as it comes from the battery is cooled to a temperature below 40°C., and treated with a cold solution of aluminium sulphate so that alunite (basic aluminium sulphate and potassium sulphate) forms with the alkali salts already present; then carbon dioxide is led in, but after it has been turned on for about half a minute, milk-of-lime at a density of 30° Bé. is gradually added in small amounts at a time, until a total amount of about 2½ per cent. (calculated on the weight of roots worked has been used), the carbon dioxide being shut off when a slight pink coloration is indicated by means of rosolic acid indicator. Without any heating, the juice is passed through filter-presses, and if necessary also through mechanical filters, after which it is concentrated to 65–70° Brix in a Kestner or similar apparatus at a temperature of 80–90° C. A syrup is thus obtained which is quickly neutralized with carbon dioxide, filtered, and boiled to a coarse grain with a high vacuum. A white direct consumption sugar is thus obtained which, as already stated, does not require to be washed with water, or covered with steam. As to the molasses swung off, this is collected, and when a sufficient amount has accumulated, it is diluted with water from the condenser; and (if alkalis are still present) sufficient aluminium sulphate is added to form the insoluble alunite, which is filtered off. Then another boiling is made from it, and the resulting massecuite centrifuged hot, when again a direct consumption sugar is obtained. Owing to its purity the second molasses can be used for the preparation of liquors. Yet other advantages claimed for this method of operating are: that the non-sugars are largely eliminated; that a filter-cake is obtained rich in alkalis and in assimilable nitrogen, that owing to the hardness of this cake, filtration is very rapid; and that both fuel and labour costs are about half of those ruling in the present method of working.

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Purification of Molasses, using Sulphurous or Hydro-sulphurous Acid. *"Reinzucker" Gesellschaft für Patentverwertung m. b. H.*, of Berlin. *363,559*. December 10th, 1919.

Low grade molasses (*i.e.*, those having a purity less than 70°) are diluted to 55–60° Brix, intimately mixed with 0·1 to 0·15 per cent. of lime, and submitted to treatment with sulphurous, hyposulphurous, or hydrosulphurous acid so as to give an acidity of 0·08 to 0·18, after which it is filtered. In this way (it is stated) a liquid is obtained from which a light coloured massecuite may be boiled. Crystallization is complete after some days, and on centrifuging a good yield of a sugar polarizing 92–95° is the result.

Process for the Production of Direct Consumption White Sugar from Raw Sugar Massecuite. *Albert Reiher*, of Berlin, Germany. *363,560*. November 21st, 1922.

Claim is made for a method of producing direct consumption white sugar from raw sugar massecuite thereby characterized in that the massecuite is centrifuged, the resulting crystals so diluted with another syrup that a saturated or almost saturated solution is formed, the remaining crystals washed by covering, pugged with saturated or almost saturated syrup of high purity, centrifuged, and finally covered with steam.

Sugar Crops of the World.

(Willett & Gray's Estimates to July 5th, 1923.)

	Harvesting Period	1922-23. Tons.	1921-22. Tons.	1920-21. Tons.
United States—Louisiana	Oct.-Jan.	263,478	289,669	150,996
Texas	,, ,,	2,875	2,920	6,238
Porto Rico	Jan.-June	338,456	362,442	438,494
Hawaiian Islands	Nov.-July	467,000	502,194	504,073
West Indies—Virgin Islands	Jan.-June	6,000	5,000	4,500
Cuba	Dec.-June	4,000,000	3,996,387	3,936,040
British West Indies—Trinidad	Jan.-June	55,000	59,948	54,933
Barbados	,, ,,	50,000	36,742	24,817
Jamaica	,, ,,	38,000	42,167	39,960
Antigua	Feb.-July	12,000	9,850	11,320
St. Kitts	Feb.-Aug.	15,000	8,426	8,063
Other British West Indies	Jan.-June	10,000	9,238	3,603
French West Indies—Martinique	Jan.-July	19,700	18,329	23,834
Guadeloupe	,, ,,	30,000	32,000	25,426
San Domingo	Jan.-June	190,000	225,000	185,546
Haiti	Dec.-June	12,000	12,283	5,625
Mexico	,, ,,	120,000	119,800	115,000
Central America—Guatemala	Jan.-June	20,000	19,090	17,500
Other Central America	,, ,,	28,000	27,972	36,692
South America—				
Demerara	Oct.-Dec. and May-June	101,128	107,797	96,168
Surinam	Oct.-Jan.	11,000	10,000	9,394
Venezuela	Oct.-June	16,000	16,000	22,806
Ecuador	Oct.-Feb.	8,000	7,000	6,998
Peru	Jan.-Dec.	340,000	319,864	344,024
Argentina....(1923-24, 225,000)	May-Nov.	200,000	172,236	202,158
Brazil	Oct.-Feb.	425,000	491,933	340,063
Total in America		6,778,637	6,904,287	6,614,271
Asia—Brit. India (consumed locally)	Dec.-May	2,988,000	2,532,500	2,506,320
Java (1923-24, 1,720,000)	May-Nov.	1,731,875	1,649,610	1,508,755
Formosa and Japan	Nov.-June	405,800	406,966	342,176
Philippine Islands	,, ,,	285,000	338,160	255,843
Total in Asia		5,410,675	4,927,236	4,613,094
Australia........(1923-24, 290,000)	June-Nov.	306,678	299,465	167,401
Fiji Islands	,, ,,	52,000	65,000	73,000
Total in Australia and Polynesia		358,678	364,465	240,401
Africa—Egypt	Jan.-June	90,000	100,000	79,706
Mauritius....(1923-24, 200,000)	Aug.-Jan.	231,190	197,420	259,872
Réunion	,, ,,	40,000	55,564	42,688
Natal (1923-24, 200,000)	May-Oct.	158,221	155,194	142,851
Mozambique	,, ,,	45,000	34,446	51,009
Total in Africa		564,411	542,624	576,126
Europe—Spain	Dec.-June	6,000	5,000	6,886
Total cane sugar crops		13,118,401	12,743,612	12,050,778
Europe—Beet sugar crops....(1923-24, 5,290,000)		4,510,704	3,996,707	3,681,461
United States—Beet sugar crop	July-Jan.	615,936	911,190	969,419
Canada—Beet sugar crop	Oct.-Dec.	12,400	18,931	34,600
Total beet sugar crops		5,139,040	4,926,828	4,685,480
Grand total Cane and Beet Sugar	Tons	**18,257,441**	**17,670,440**	**16,736,258**
Estimated increase in the world's production	,,	587,001	934,182	1,535,857

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922. Tons.
Total Receipts, January 1st to July 25th	1,965,586	..	2,588,881
Deliveries ,, ,, ...	1,956,169	..	2,524,708
Meltings by Refiners ,, ,, ...	1,835,560	..	2,369,863
Exports of Refined ,, ,, ...	183,000	..	660,000
Importers' Stocks, July 25th	9,417	..	64,173
Total Stocks, July 25th	130,545	..	221,323
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1920 21 Tons.		1921-22 Tons		1922-23 Tons.
Exports	1,510,416	..	2,377,510	..	2,602,339
Stocks	1,416,943	..	844,622	..	590,209
	2,927,359		3,222,132		3,192,548
Local Consumption	64,000	..	75,000	..	67,500
Receipts at Port to June 30th	2,991,359		3,297,132		3,260,048

Havana, June 30th, 1923 J. GUMA.—L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to July 5th, 1923.)

	Harvesting Period.	1922-23. Tons.	1921-22. Tons.	1920-21. Tons.
Germany	Sept.-Jan...	1,500,000	1,305,810	1,152,960
Czecho-Slovakia	Sept.-Jan...	725,000	659,907	705,919
Hungary and Austria	Sept.-Jan...	93,976	91,220	47,644
France	Sept.-Jan...	510,000	306,073	305,041
Belgium	Sept.-Jan...	268,871	289,866	242,589
Holland	Sept.-Jan...	260,000	340,990	317,196
Russia (Ukraine, etc.)	Sept.-Jan...	193,400	49,374	88,490
Poland	Sept.-Jan...	330,000	179,096	189,834
Sweden	Sept.-Jan...	71,790	231,066	164,194
Denmark	Sept.-Jan...	88,382	146,800	134,835
Italy	Sept.-Jan ..	260,000	217,532	135,484
Spain	Sept.-Jan...	160,035	135,000	170,722
Switzerland	Sept.-Jan...	8,000	5,500	3,710
Bulgaria	Sept.-Jan...	16,250	12,712	7,837
Rumania	Sept.-Jan...	25,000	25,761	15,006
Total in Europe		4,510,704	3,996,707	3,681,461

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No. 297. SEPTEMBER, 1923. Vol. XXV.

Notes and Comments.

The Catastrophe in Japan.

What must be surely the biggest catastrophe of modern times has just stricken the commercial heart of Japan and in a few hours left her two largest cities almost completely wiped out by earthquake, fire, and tidal wave. The first report of the disaster was fortunately exaggerated as regards the number of killed, but even as it actually was, the death roll has been very heavy, and occurring in what was the intellectual centre of Japan must have robbed that country of a much larger proportion of its educated and ruling class than would otherwise have been the case. As for the damage done, at the time of writing it is estimated that three-quarters of the buildings in Tokio have been totally or partially destroyed, while two-thirds of her population have been rendered homeless. Yokohama, Japan's principal seaport, appears to have been even more completely destroyed.

One's sympathies unfailingly go out to this eastern nation in the hour of her trouble. Her commerce must have suffered a serious setback which will take months if not years to make good. To us at home a parallel disaster would be the destruction of a large part of both London and Liverpool. Nevertheless the recuperative power of Tokio and Yokohama is undoubtedly greater than that of any western cities, and the stoicism and discipline ingrained in the Japanese people will almost certainly result in a more rapid recovery than the statisticial position would suggest. But Japan is not a rich nation and it is probable that the rest of the world will have to co-operate financially in rebuilding her razed cities. In view of the burdens engendered by the late war, this additional one, arising out of one of Nature's periodical cataclysms, must put a further strain on the world's already straitened finances.

World Supplies of Sugar this Autumn.

From Lamborn & Company of New York, the well known sugar brokers, comes to hand the second of their new series of sugar statistical reports, consisting of a 64-page pamphlet, giving remarkably detailed statistics of the sugar conditions of the different countries of the world, together with a reasoned forecast of the world's sugar supplies at the end (*a*) of the crop year, that is August 31st, and (*b*) of the calendar year—December 31st. Estimates of the production, con-

sumption and supplies of sugar at these two dates are given relating to no less than 67 different countries of the world.

The statistical position of the world as a whole is shown to reflect marked improvement in sugar conditions during the four closing months of the year. The simplest analysis of these conditions by a comparison of production and consumption shows that if the crop year has been a period of very inadequate production, the calendar year will prove, according to Messrs. Lamborn, a period in which production will practically suffice to meet consumption without any further withdrawals from stocks. This improvement is mainly due to an increase in the European beet sugar crop which Messrs. Lamborn writing in July put at 750,000 tons, their total of the crop being 5,190,000 tons.

To show the improvement expected in the coming four months, Messrs. Lamborn give a table of comparison of actual and normal stocks for the world. On August 31st, 1922, the actual stocks were 209,000 long tons above normal, while at the same date this year the probable stocks were 142,000 long tons below normal. On December 31st, 1922, the actual stocks were 132,000 long tons above normal, while next December they are expected to be 94,000 long tons above normal. In other words, while on August 31st last the balance sheet of the world's production and consumption indicated a shortage of 142,000 long tons to be made good by further withdrawals from stock or a curtailment of consumption, the balance sheet at December 31st next, as forecasted by Messrs. Lamborn, indicates a surplus of 94,000 tons, either to be added to stocks or to increased consumption.[1] Incidentally, the probable world's consumption for the calendar year 1923 is put at 19,375,000 long tons.

The Past Year in Jamaica.

The Jamaica Director of Agriculture (Mr. H. H. COUSINS) in his report on agriculture in Jamaica during 1922 writes with some confidence of the prospects of development in that island. The year in question was one of deficient rainfall and in some areas of the island acute conditions of drought prevailed so as to cause serious loss and suffering to the community. But thanks to the favourable rainfall of the previous year, the sugar industry did well, achieving the high record of 57,000 tons of sugar or just double that exported in 1921. It was in most respects a normal year for trade generally with low or moderate prices prevailing in foreign markets for the island produce, and yet the value of the exports amounted to £4,316,000 as against £3,139,177 in the previous year. This record is considered encouraging, as justifying greater confidence in developing the resources of the island and in the extension of cultivation and the opening up of the hinterland.

Unfortunately for the sugar industry low prices prevailed till the closing period of the crop, after which a marked improvement in the value of sugar took place. Hence, despite the large production, most of the estates made small profits and in some cases have actually lost money on the year's operations. But for 1923 a higher standard of value for sugar has, of course, been established, and the industry now begins to see itself with a reasonable future for assured production. The policy of Government assistance to the sugar industry when it was *in extremis* as a result of the sensational fall in prices in 1921 has been fully justified by the results. The industry was saved and is now in a position to establish itself on a secure basis.[2]

[1] But since the latest forecast of the Continental production is about 200,000 tons less than the figure ruling in July, a deficit of over 100,000 tons below normal would appear to be more likely.—ED.

[2] Unfortunately the latest reports of the 1923 crop indicate that it will not exceed 33,000 tons, while that of 1924 is not expected to be much greater.—*Ed.*

But Jamaica rum has been almost unmerchantable. The attempt to organize a co-operative factory for the manufacture of motor spirit from rum fell through owing to lack of agreement amongst the producers. The effect of the failure of the rum market is a very serious one for the Jamaica sugar industry, as the existing factory equipment is not efficient for the manufacture of sugar. Jamaica has, as is well known, always relied on the by-product, rum, to make good the losses on the recovery of sugar in the factories. But if the present contretemps leads to the overhauling and modernizing of these factories it will, in our view, be all to the good for the Island's sugar industry, and to that extent the failure of the rum market may prove a blessing in disguise.

Further Developments in Jamaica.

Reports have recently been rife that a group of Scottish financiers were about to develop the eastern portion of Jamaica, and the *Times Trade Supplement* recently gave some details of the plans. The scheme includes a network of railways converging on Port Morant, an improved harbour at the latter place, and a sugar factory with a minimum capacity of 10,000 tons but capable of unlimited expansion. This last is contingent on the guarantee of 5000 acres at least of cane; but it is said that on the plan being made known locally 3000 acres were forthcoming at once, while other parties have expressed their willingness to turn over their banana lands to cane cultivation. The district includes some of the most fertile lands in the island. The announced terms on which canes will be taken from the growers are considered to be exceedingly satisfactory. The contract to supply would be for 25 years; and the basis of payment 5 per cent. when the price of sugar does not exceed £15 per ton, 5½ per cent. when it exceeds £15, and 6½ per cent. when the price is above £20 per ton.

Amongst the promoters of this scheme are stated to be the Duke of Athol, Lord INVERNAIRN (better known as Sir WM. BEARDMORE), Sir FREDERICK McLEOD, and Messrs. Duncan Stewart & Co. Limited, and it is proposed that not only will the share list be thrown open to investors in Jamaica, but the Colonial Government will be invited to become financially interested in the project. The extension of railway facilities which forms part of the plan is calculated to bring under cultivation thousands of acres of lands in the hilly regions which have been left in a state of neglect for want of transport, so it is evident that now capital at home has been led to give its attention once more to this colony, a considerable development of agricultural and manufacturing industry is in prospect, which will open up new ground and not merely modernize existing operative areas. Altogether, the indications point to a new and brighter era dawning for Jamaica, if these plans are brought to successful completion.

Sugar Profits in Java.

The recent rise in the price of sugar has of course benefited Java sugar interests equally with others, and the 1922 standard of profit should be greatly exceeded this year. The average sale price for the 1923 crop is expected to work out at Fl. 13·60 per picul, while it is reported that one million piculs of the 1924 sugar crop have been sold on the Amsterdam exchange already at Fl. 15, which is evidently looked on as a satisfactory figure. Incidentally, in 1920 the first million piculs were sold forward at Fl. 45 and the last at Fl. 12 or Fl. 13.

According to *Commerce* of Calcutta, the chief sugar concerns of Java have issued reports for the past year disclosing results of a highly satisfactory nature. These companies represent for the most part a combination of manufacturing and

of selling interests; but the latter activity has lost practically the whole of its importance since the formation in 1918 of the Java Producers' Trust, which is responsible for the sales organization of nearly 85 per cent. of the Java sugar producers. The management is formed by the Netherlands Trading Company, the Netherlands Agricultural Company, which is entirely controlled by the Netherlands Indian Trading Bank, and the Handelsvereeniging Amsterdam. These three concerns together control not far less than 50 per cent. of the 25,000,000 piculs (1,500,000 tons) which is yearly sold by the Producers' Trust. The results achieved by this system of co-operation form the best inducements for its continuation. The Cultuur Maatschappy der Vorstenlanden and the Colonial Bank are both important members of the Java Producers' Trust, the Vorstenlanden controlling over 2,000,000 piculs of sugar produced by 14 factories, of which three are entirely its own. The Colonial Bank had about 2,400,000 piculs under its control in 1922, of which 500,000 piculs were its own. The balance came from nine factories, in which it has a more or less controlling interest. These two institutions together controlled in 1922 not much less than 5,000,000 piculs of sugar, say 20 per cent. of the whole crop. The Vorstenlanden has paid 10 per cent. on its Fl. 18,500,000 ordinary share capital and the Colonial Bank 11 per cent. on its Fl. 13,750,000 shares. This relatively good result is due in a certain measure to the splendid crop conditions in the past year, thanks to which the factories under the auspices of the Colonial Bank have produced 20 per cent. more sugar than in 1921, and the Vorstenlanden 2,300,000, against 2,100,000 piculs. The Colonial Bank not only had a greater acreage under cultivation, but the production per area was substantially better than in 1921 and not less than 12½ per cent. better than in 1920, which was a decidedly unfavourable year as to quantitative results.

Progress in Electrification in Cuban Sugar Factories.

In a contemporary[1] the engineer of an American firm of electrical machinery manufacturers recently sketched the growth of the electrification of sugar factories in Cuba, and gave figures showing that in the 1921–22 season (by which time the halt in the rapid extension of sugar mills in that island had taken place) eighty out of a total of one hundred and ninety-two Cuban centrals had been completely or partially electrified, and out of a total of four million tons of sugar produced in 1922, 2,610,000 tons, or 65 per cent., came from these electrified factories. These figures certainly speak volumes.

Although a few modern centrals in Cuba had been electrically driven prior to 1914, it was the world war that furnished the incentive and favourable conditions that introduced electrical drive on a large scale. It brought along high prices for sugar, and this led to the introduction on a large scale of American capital in the island, which was less conservative than the older Cuban proprietary about introducing revolutionary changes. The result was a gradual quickening in the conversion of old mills to electrical drive, and in the more or less complete electrification of new mills.

The first use made of electricity was in lighting the mills, for which a low voltage direct current supply was a necessity; then followed the introduction of a few motors to drive machinery at points beyond the steam piping lines, and these being proved efficient the power units were extended. But it was eventually found that the direct current motors gave trouble under conditions of moisture, dust, and the generally severe operations encountered in a raw sugar mill, so reversion was had to the alternating current system which has since become

[1] *Sugar News*, Vol. IV, No. 7, 367–370.

practically standard. The cost of the control equipment and power wiring is less for high voltages, but on the other hand the danger to the operator and the chances for electrical failure are greater, so a compromise voltage was selected and 3-phase, 60-cycle, 440-volt current was settled on as best meeting all conditions. The use of alternating current made possible the transformation to 110 volts for lighting, and the voltage could also be stepped up to 2300 volts or higher for economical transmission to distant pumping plants or nearby towns. The first installation of electrical motors on a comprehensive scale was made in 1911 at Central Delicias which drove practically all of the machinery except the rolls. To Central Amistad belongs the distinction of first applying motors for driving the crushing rolls, this factory dating from 1913.

The benefits derived from the substitution of electric for steam power, it is pointed out, are found to come more from the reduction in exhaust steam, from clean steam delivered by the turbines driving the electric generators, from the reduction in the working force and in the supplies (principally oil), from the more economical arrangement of the factory equipment possible, and from the increased output due to the decrease in lost time—than from better efficiency from a purely power standpoint. The grinding mills indeed have not changed from steam to electric drive as rapidly as have the other stages of manufacture, doubtless due to the opinion held by many engineers and mill owners that the steam engine is better suited to this part of the factory.

The above notes refer of course solely to Cuban history and practice. There were electrically-driven mills in Porto Rico, Mexico, and Argentina before the time of Cuba's pioneer electrified mill, but Cuba was the first to start well on the road to electrification, and she now appears to be reaping the advantages of her progressive enterprise, for complete electrification in the opinion of its advocates is one of the big factors in accomplishing the desired end of lowering manufacturing costs in order to make acceptable profits.

The German Sugar Outlook.

The British Commercial Secretary at Berlin has forwarded to the Board of Trade a report from the *Berliner Tageblatt*, which states that the month of July passed without any decision having been reached in Germany with regard to the form of control of sugar in the coming working year. So far, it is only certain that control in its present form will not be maintained, but will be considerably diminished. How far this will be the case will probably depend on the results of this year's harvest. If it is favourable, the covering of the inland demand will, in any case, be ensured. Then, apart from the regulation of exports, there will probably be complete freedom of trade in sugar. If, however, the harvest is unfavourable, sugar cards will probably have to continue.

The area under sugar beet cultivation in Germany has only recently been definitely ascertained. According to the answers given by the sugar factories to a Government questionaire, there is a reduction in the area under cultivation of about 5½ per cent. as compared with the previous year. The previous year's harvest was described as an average one, and the amount of sugar obtained from it just suffices to cover the constantly increasing demand. If the harvest this year is not better, then the German demand will not be able to be completely covered without the help of foreign sugar. As conditions are at present, a far better harvest can, however, be reckoned with. The condition of the sugar beet throughout the whole of the country is, almost without exception, exceedingly satisfactory, and a full harvest may already be relied upon if the weather remains tolerably normal, though it will be later than usual.

Fifty Years Ago.

From the "Sugar Cane," September, 1873.

There were a good number of technical articles in this issue of our predecessor. One was entitled "On the Manufacture of Sugar from the Sugar Cane, and the Machinery employed therein," and was the concluding article of a series published by an anonymous writer. This particular contribution described apparatus for breaking up massecuite which had been allowed to set in the coolers, in order thus to prepare it for curing. Several machines were described and illustrated for this purpose; and one arrangement consisted of a number of knives set in a spiral on a revolving shaft, these revolving blades passing between fixed ones, so as effectually to break up the mass of sugar submitted to their action. Both revolving and fixed knives were much thicker at one end of the machine, the mass being first coarsely broken up by these, and then passed by the spiral arrangement to the thinner blades for finer subdivision. This article also described improved apparatus for carrying out the operation of claying.

One of the several articles on analytical methods was by the well-known chemist LANDOLT. For the purpose of fixing the duties on various sugars and to establish the relation between the several grades of raws and refined, a large quantity of raw beet sugar had been refined at Cologne, the necessary analyses being carried out by the author of this article, who here described his methods. For the determination of sucrose, he had used three different polarimeters: (1) Soleil's (made by Duboscq, of Paris) with a double plate quartz compensator, and tubes 200 mm. long; (2) Ventzke-Soleil's (made by Schmidt & Haensch, of Berlin) with a Soleil double plate quartz compensator, and tubes of 200 mm.; and (3) a Wild's polaristrobometer (made by Hoffman, of Paris) with a Savart-Wild double quartz, and again tubes of 200 mm. He made observations of the accuracy of reading with these instruments, and he concluded that the mean error was (1) $\pm$ 0·40; (2) $\pm$ 0·20; and (3) $\pm$ 0·03° respectively for the three types.

A translation was published of an article by FELTZ drawing attention to the fact that crystallizable sugar exerts a reducing action on "the potassio-cupric solution of Barreswil," his conclusion as the result of a number of experiments being as follows: "It thus appears without doubt that crystallizable sugar reduces the copper solution under the influence of an excess of alkali. The estimations so frequently made of glucose in a mixture of the two sugars have only a relative exactness, and become entirely inaccurate as soon as it is necessary to estimate traces of glucose in the presence of large quantities of crystallizable sugar."

Other articles of interest to the chemist were entitled: "Experiments with Manures in the West Indies," by T. L. PHIPSON; "The Saccharimeter, its Formation and Use," by H. A. SMITH; "Use of the Saccharimeter and of Chemical Analysis for the Analysis of Raw Sugars," by M. ANGENOT and others; and a note on the "Modification of the Optical Saccharometer," by M. PRAZMOUSKI. This latter described his polarizer.

There was finally an anonymous article on the cane borer, which described in detail the pest, and its method of attacking the cane. In regard to remedial methods, it was remarked after discussing several other means that "there remains the use of fire by burning all parts of the cane which do not pass through the mill. This remedy appears to us to be quite practical, relatively easy, and quite certain, provided it be applied with perseverance, intelligence, and unity of purpose."

The Irrigation of Sugar Cane in Hawaii.

(*Continued from page 408.*)

Conservation of water (prevention of losses from source to furrow) and Soil moisture studies : It soon became obvious that to prevent serious loss in transport considerable attention would have to be paid to the water channels. Losses may occur in surface run-off, water and soil evaporation, leakage, seepage and deep percolation beyond the range of roots at different stages of growth. Such losses may occur in reservoirs or in transporting or delivering channels, and as far as these are permanent may be prevented or largely reduced. Owing to the large volumes of water dealt with and the great distances over which they have to travel, together with the porous nature of much of the Hawaiian soil, it became evident that some form of waterproofing of the channels was necessary,[1] and that the channels should be kept in constant repair. A great deal of attention has been devoted in Hawaii to this vital matter in irrigation. The following appear to be the chief lining materials which have found favour from time to time, smoothness of lining surface being essential to pass the current quickly and thus to speed up the work and prevent undue evaporation. Flumes with wooden sides are specially liable to get out of order because of the material used, and a case is given where mere overhauling of the transporting flume resulted in increasing the water delivered by 18·55 per cent. The other lining materials mentioned by the author are cement or concrete reinforced by chicken wire (wire netting), concrete, pre-cast concrete slabs, and rock or stone blocks. A number of details are given regarding the behaviour of all of these, and the matured opinions of a number of leading planters are freely quoted. The Pioneer Mill Company reports regarding its main transporting ditch "which passes through the Honokahau tunnel seven miles long, was constructed in 1921 and has been in continual operation ever since. The walls are lined with plaster, reinforced with chicken wire, the whole being attached by heavy wire staples driven into the sides; the floors are cemented. The walls have proved very unsatisfactory. It is necessary to shut down the ditch for three days in each year and employ a large force of labour in plastering over hundreds of small holes and cracks. In some instances whole sections of the lining are torn off bodily. The seepage loss in dry weather flow amounts to 25 per cent." This is thoroughly typical of the general opinion regarding this material, which, however, can be used for short distances with advantage where the channel is only used intermittently. (Fig. 4.)

Concrete lining on the other hand is found to be very efficient but, to prevent cracking owing to changes in temperature, expansion joints have to be inserted at intervals. These were put in by one plantation at every 15 ft., while another has used 40 ft. but considers that shorter sections would be advisable. In gritty water the concrete lining has been found in time to be badly cut, and expensive settling tanks have had to be inserted at intervals on one plantation. Pre-cast concrete slabs installed by PENHALLOW have met with approval on all hands (Figs 5 and 6). These were described in our former article,[2] and although somewhat costly in the first instance are generally considered to have solved the problem of ditch lining. Cut stone or rock set in mortar is only used for excessively steep gradients, so as to withstand the great wear and tear. This material has proved satisfactory in

[1] The writer of this review has met with a case where it was attempted to irrigate cane fields by an unlined channel some twelve miles long from a large reservoir The loss of water by evaporation and seepage was found to be 95 per cent. before it reached the fields.

[2] *I.S.J.*, 1923, 181.

such places, but it is found difficult to construct the channel so that the lining is perfectly impervious.

The level ditches cannot be lined, and the average loss by seepage has been estimated by BALDWIN at the Maui Agricultural Company's Plantation at 22·6 per cent. The remedy suggested is to avoid all small irrigations, e.g., 1–2 men's irrigation on successive days should be replaced by 4-6 men's in one day only, thus lessening seepage and evaporation. A case is given when, because of water shortage, a large gang replaced 4–5 smaller ones for a time; the irrigation was completed in 22 instead of the usual 30 days, and at the end there was found to be 10 "men's water" left over. As to watercourses it is a moot point how much of the seepage water finds its way ultimately to cane roots. BALDWIN attempted to settle this question by soil moisture tests. The water was run in for 1¼ hours, and two days later the increase in moisture 1 ft. off was found to be 3·85 per cent., at 2 ft. 3·12 per cent., and at 3 ft. 1·04. He therefore concluded that lateral percolation was slight. ALLEN holds that the loss from water courses is not serious, and that the water finds its way somehow back to the cane roots.

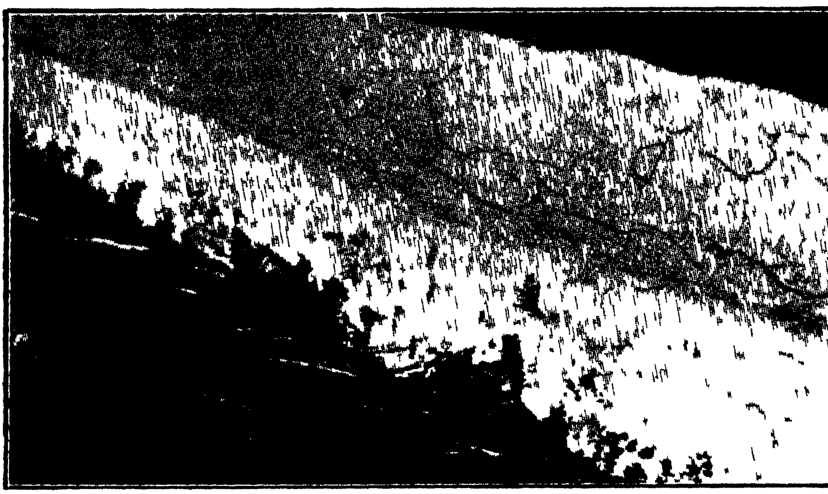


FIG. 4.—CHICKEN WIRE AND CONCRETE PLASTER LINING DAMAGED BY EROSION AND TEMPERATURE CRACKS.

The water in the furrow is disposed of, according to the author, in four ways: (1) surface run-off, due to leaking gates, carelessness and poor methods of irrigation; (2) soil evaporation, but this becomes regulated as soon as the leaves close over the ground and through the natural mulch of self stripping canes while the humidity of the Hawaiian climate acts as an additional check; (3) transpiration, but this serves a useful purpose, though weeds also transpire and clean weeding is therefore desirable (the author does not mention the quantity also taken up by the crop itself); (4) deep percolation, which is of most importance, that is the passage of the water below the root zone. He points out that the amount of water which the soil can hold varies with the texture, and gives the figures for the surface of the united particles of the three main types; the particle surface in an acre-foot of clay soil being 16,000 acres, in loam 10,500 and in sandy soil 3,250. Cane roots seldom reach below 4-5 ft., therefore all the water supplied should remain at that depth.

At Waipio sub-station (ordinary loam) the water movements were traced to 6 ft. from the surface, under 2 in., 6 in. and 9 in. irrigations. With the first it was found that 3 per cent. passed the 6 ft. line, with 6 ins. the figure was 47 per cent., and with 9 ins. 65 per cent. Under Waipio conditions it was determined that the upper 6 ft. of the soil could not retain more than 4½ ins., and it was therefore concluded that if more than this amount of water is applied the excess passes away and is lost. The soil moisture studies by the author agree with these figures. These studies were carried out between August 1921 and April 1922 on three areas on Ewa plantation differing in soil and slope of land; each soil moisture determination used was the result of three separate readings. The results are summarized on three charts with graphs representing the percentage of soil moisture each week at a series of different depths down to 5 or 6 ft. He found that the soils on the estate were saturated with a moisture content of 30 per cent., and any irrigation beyond this point was therefore wasted. Wilting (indicated by a slight curling of the leaf) occurred in warm weather when the soil moisture fell to 21 per cent. and slightly lower in the winter, and he therefore

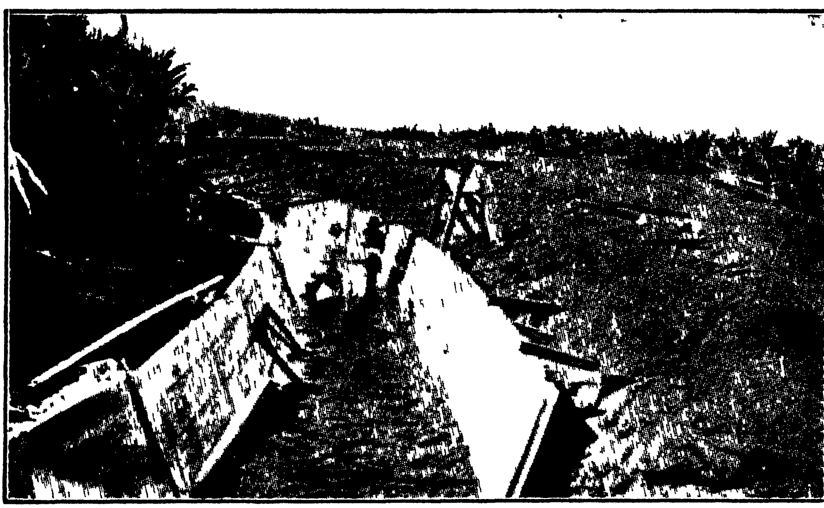
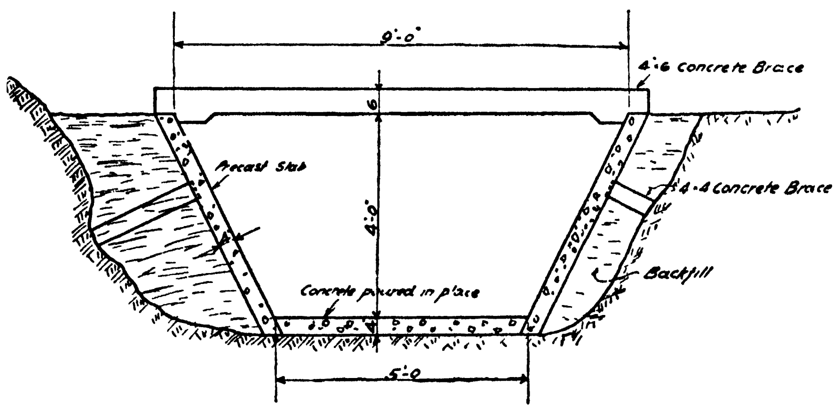


FIG. 5.—SETTING CONCRETE SLABS IN PLACE IN FLOWING DITCH.

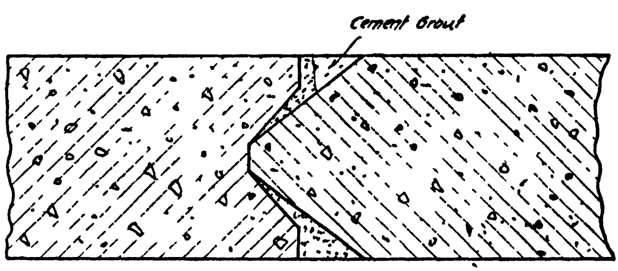
arbitrarily fixed on 25–28 per cent. as the point when irrigation is needed, soils with this amount of moisture still retain the "good feel" well known to experienced irrigators. His data showed practically no upward capillary movement, drying out always proceeding downwards. During cold weather when growth and evaporation are at a minimum, sufficient soil moisture is retained for as long as three months at a time with comparatively slight rainfall, and irrigation is not needed, if indeed it is not harmful; but on the advent of warm weather the soil commences to dry very rapidly. Thus the soil moisture conditions vary with the season. Provided that drainage is adequate, it is probable that one year old cane can do with a far greater amount of water during the warm weather than is usually given. He concludes that it is not practicable to regulate irrigation practice by soil moisture measurements. For this to be effected on a large field, with its soil variations, composite samples are of little value, and the multiplicity

of measurements which would be needed would be extremely cumbersome. Besides this there is another practical difficulty in a large field. Supposing that irrigation is commenced when the soil moisture is found to be 24 per cent., the irrigation work is too slow a process to prevent some parts of the field from suffering severely from lack of water. One cannot irrigate a 100 acre field in a day. The use then of soil moisture determinations is confined to check proper distribution and for purely research work. In actual practice, the accumulated

WAILUKU SUGAR COMPANY



CROSS SECTION OF DITCH



DETAIL OF JOINT

Fig. 6.

experience of years of irrigating gives the overseer a kind of intuition as to when irrigation is needed; true, he probably errs on the side of over-irrigating, but he does not allow the leaves to show any signs of wilting and can afford a certain margin in keeping the plants fully employed in healthy growth, and he may be trusted not to waste any material amount of water.

In the remaining sections the author is much more concise, and it is chiefly in these that a more generous treatment would have been welcomed by outside readers, inasmuch as they are perhaps of more general interest to sugar planters. Considerations of the length of the thesis have doubtless had their influence in this curtailment.

Naturally, the time element in irrigation is of great importance where the labour shortage is so severely felt as it is in Hawaii. The points considered in this section are whether irrigation of the furrows should commence at the upper or lower end of the watercourse, the volume of water used per man, the effect of stripping and of weeding and the age of the cane, and, lastly, the personal element in the labour, whether depending on nationality or the previous training of the irrigator. Notes are recorded of results obtained in the year preceding the publication of the thesis, the two-way Ewa standard system being employed throughout.

(1) As regards the direction upwards or downwards along the watercourse, a main point to be considered is the consolidation of the soil along the watercourse as irrigation proceeds, with a correlated increasing rapidity of flow and reduction of seepage. The conclusion arrived at appears to be that an alternate irrigation upwards and downwards gives satisfactory results.

(2) The volume of water used per man depends on the permeability of the soil, the character of the cane, and the care taken in previous irrigations of preserving the contours of the channel. Taking a considerable slope and perfectly level land as extremes, flows between 0·3 second-feet and 0·75 are considered most useful; and if anything like the latter quantity is used for land sloping much, the watercourses are ruined and all economical irrigation comes to an end. With soft ridges between the furrows, however, a 50 per cent. reduction would be imperative for at least the first six months. In young canes the channels will be comparatively unobstructed and 0·5 second-feet should not be exceeded, but when the weight of cane approaches 75 tons to the acre this might be increased to 1·0 second-feet, and when there is more cane on the land than this to 1·5.

(3) Proper stripping of the cane is the mark of a good irrigator, who will arrange the dead leaves in small bundles on the side for use as *panis* or temporary dams to regulate the flow when needed. There is, however, a tendency to neglect the stream while engaged in stripping, and to pull off the leaves before they are ready for detachment from the plant. It is found that there is usually time for the treatment of one side of the watercourse during each irrigation, the opposite side being left to the next watering some three weeks later. In case this is not attended to and the stripping falls a couple of months in arrear, a separate operation will become necessary.

(4) Weeding must never be allowed to cause neglect of the irrigating stream. Slowing the current behind the weeder, which is sometimes done, has its disadvantages; waste of water will occur through seepage and evaporation, and there is danger that the weeds when pulled out may be covered with earth and then wetted, when they will soon sprout again. It is better to allow them to wilt thoroughly before irrigation succeeds weeding.

(5) The age of the cane is of course of very obvious influence. At four months an irrigator may cover 1·5 acres in a day, while at 12 months the same man will only be able to deal with 1·0 acre, and at 18 months 0·7.

(6) The class of labour is a vital matter, as it is impossible to supervise, especially in old cane, on a large scale. It is important to interest the irrigator

in his work, for instance, by paying a bonus on yield at harvest. But here nationality comes in; such an arrangement will cause a Japanese to put in the best possible work, but the Filipino is not gifted with a two-year vision, and the results will not be known for something like that period of time. Bad habits once indulged in are very difficult to eradicate, so that it is all-important to thoroughly train the irrigator at the start when he can be kept under observation. It is the custom to keep the same man at one watercourse, and with a little intelligence he will soon gauge its peculiarities and know the wet and dry places in its length, and be able to treat them accordingly.

The water pumped up from artesian sources in Hawaii is often more or less brackish, and sometimes markedly so; and the effect of saline irrigation of the sugar cane has from the first naturally attracted much attention. As is well known, the first effect of such irrigation is a paling of the leaves of the cane; with increasing quantities of salt, the leaves become yellow and growth is stunted, and ultimately the leaves become chlorotic and the plant dies outright. Paradoxical as it may seem at first sight, the main remedy is to increase the volume of water given, so as to prevent any accumulation of the salt in the soil through absorption, which is especially likely when there is the chance of rapid evaporation. The plant appears to be able to take up the salt from the irrigation water with comparative ease, and within limits this is attended with no harmful effects, but when these limits are passed the results are disastrous, both as regards growth and the character of the juice.

Various more or less detached observations and experiments are detailed by the author, those by MAXWELL and ECKART being the most fully dealt with. These can only be lightly referred to here. According to Maxwell's observations the danger limit may be considered to be reached when the water contains 0·14 per cent. of salt in solution or 100 grains to the gallon. ECKART observed that saline water renders available from the soil large quantities of lime, magnesia and potash, and points out that, in consequence of this, with the excessive irrigation required when the water is brackish there is likely to be enormous leaching out and loss of these valuable constituents. For such excessive irrigation to be of use in preventing the accumulation of salt in the upper layers of soil through evaporation, it is necessary for the soil to be porous and drainage to be easy and good. A case is given of an estate with good drainage, which has been watered by salt water for the past 25 years without any ill effects on the cane or increase in the saline constituents of the soil. But when drainage is at all difficult it soon becomes impossible to use brackish water. Then only temporary relief can be obtained. A mulch of trash, paper, soil, or sand may be added to reduce evaporation to its lowest limit, or the uppermost $\frac{1}{2}$–$\frac{3}{4}$ inches of soil may be bodily removed; such treatment as the latter will, it is claimed, often remove 25–40 per cent. of the total injurious salts in one operation. But these methods do not in any way remove the evil, and a thorough washing has sooner or later to be resorted to; and this can only be obtained by washing out the soil at intervals by three or four heavy irrigations with fresh water, which should suffice, and a new start be made. This important subject is, however, very sketchily treated in the thesis, which is mainly concerned with briefly summarizing the results of the more important papers.

The conservation of soil moisture is still more shortly dealt with, less than a page being devoted to it. Three practical methods are referred to: namely, the incorporation of organic matter with the soil to increase its absorptive power, covering the soil with various mulches to reduce evaporation, and the introduction

of agricultural practices to prevent the soil drying out. The incorporation of trash is universally condemned in Hawaii and in this matter the experience appears to differ from that in many other sugar growing countries, and we cannot avoid the suspicion that this view may be partly influenced by the results obtained in the United States, where of course the high temperatures of the tropics are absent and the consequent rapid disintegration of this valuable substance is retarded. A more detailed treatment of this subject would therefore have been welcomed. It is for instance mentioned that undecomposed vegetable matter in the soil is not only useless but positively deleterious and Rothamsted results are given in support of this contention. The use of trash as a mulch under irrigation is not extensively practised in Hawaii, the disadvantages being that it covers the young cane and prevents the rapid flow in the water channels; heavy cane, it is noted, provides its own mulch in six months when it covers the ground. The only agricultural practice mentioned is that of planting the cane immediately after making the furrows, the soil not having time to dry out if irrigation does not soon follow.

The application of nitrate of soda and ammonium sulphate in the irrigation water is now a general agricultural practice in the islands, and the method adopted is shown in a figure. For the purpose four barrels are used. Of these one is placed somewhere near the channel and is used thoroughly to dissolve the materials, say 100 lbs. to the barrel; two are placed on a staging, one at each side of the channel so that they may be alternately used to keep the actual supplying barrel with liquid of a fixed concentration. This last barrel is immediately over the water channel and is only of half the height of the others (i.e. a half barrel), and the main object of this simple apparatus is that the filling of this fourth barrel is so arranged that the level of the liquid in it is always kept constant, so that the flow from it to the irrigating stream is unvarying in the amount of fertilizer added per unit of time. The side barrels can be filled alternately from the mixing barrel without difficulty, one being filled while the other is emptying itself. A series of results obtained by observations and experiments are summarized, as in the foregoing sections, on the two pages devoted to the subject, from which it appears that the leaching out of nitrate of soda, which is not retained by the soil, does not appear to be as great in Hawaii as was at one time supposed.

The paper concludes with a series of Tables in which detailed results are recorded where such are available from the papers and experiments referred to.

C. A. B.

Dr. ROBERT HUTCHINSON, the eminent authority on dietetics, in the latest edition of his well-known work,[1] gives an excellent summary of facts relating to the nutritive value and economy of sugar as a food, some of his remarks (selected here and there) being as follows: Sugar is one of the cheapest fuel foods, perhaps the cheapest, which we possess, a shilling spent on it yielding 11,000 calories or more, even, than can be obtained in the form of bread for a similar expenditure. This great cheapness can hardly be without far-reaching effects on the national health, especially on the health and growth of children, for it ensures for them an ample supply of the body fuel which they so much need, and which the dearness of fat is apt to make unattainable. It is as a muscle food, however, that sugar is of special importance. It certainly seems as if it would be worth the while of captains of football teams to try the effect of serving round small cups of black coffee, strongly sweetened with sugar, at "half-time," instead of the usual lemon. They would probably be rewarded by the greater endurance of their men in the second half of the match. The fear that sugar harms children's teeth is exaggerated, and negroes who largely consume sugar cane have the finest teeth the world can show.

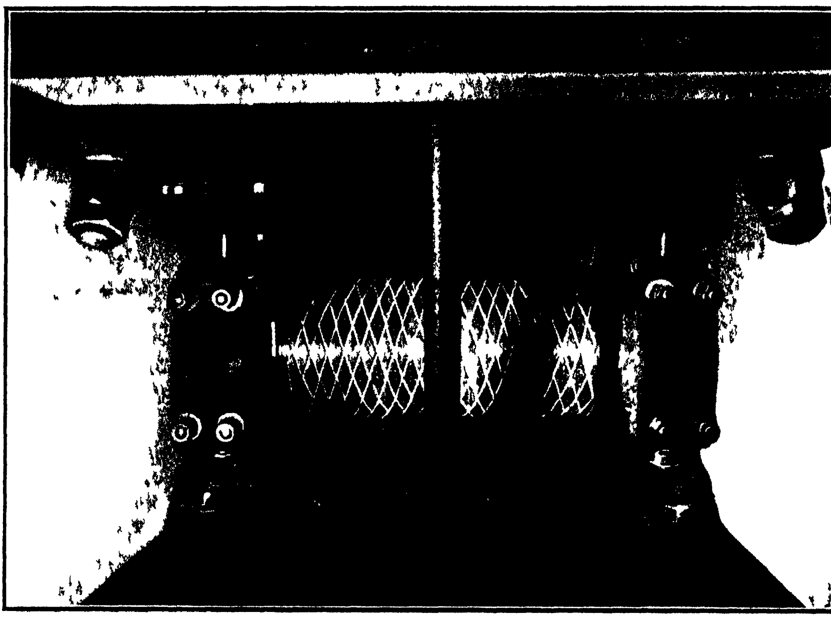
[1] "Food and the Principles of Dietetics" by ROBERT HUTCHINSON, Physician to London Hospital. (William Wood & Co., New York). 1923.

The Hinton-Marsden Grooving of Mill Rollers.

By ROBERT HARVEY, B Sc.

The invention of a new method of grooving sugar mill rolls may not at first thought appear extraordinary in the face of the many attempts which have been made to find a really efficient system; but the Hinton-Marsden type, besides possessing to an even greater degree the good qualities of many of the others hitherto proposed, also combines the particular advantage that no special scrapers are required to keep the grooves clean, since these do not clog up with bagasse.

The Hinton-Marsden grooving was first noticed in the Patent Review of this *Journal*,[1] and the nature of the improvement was fully described there. It was also specified there that the grooving takes the form of right and left hand spiral grooves of a V-shaped cross section, the depth of the grooves being ¼ in. with an angle of 60 to 65° at the bottom of the V.



HINTON-MARSDEN GROOVING ON 28 IN. × 56 IN. MILL.

The advantages as claimed by the patentees, and now substantiated, are as follows:—

1. An enormous grip, resulting in practically a forced feed, which enables the mill rolls to be set much tighter, thus giving a better extraction, and thus better preparing the bagasse for imbibition, owing to the tearing action of the grooves.
2. An increase of the milling capacity, owing to the intense grip of the rolls
3. Very much quieter running of mills and gearing, owing to complete absence of "slip" and "chokes" in the mills.
4. Less wear in rolls owing to the absence of "slips."
5. Rollers may be made of a harder and closer grained metal, since they depend on the grooves and not on the grain of the metal for their grip.

[1] U.K Patent, 189, 216, *I S.J.*, 1923, 107.

6. No special scrapers are required to keep the grooves clean, as they do not clog up with bagasse.

With a view to testing the advantages claimed, various experiments were carried out on the patentee's estate at Funchal, Madeira, this Spring, in the presence of one of the directors of the Harvey Engineering Co. Ltd. of Glasgow. The plant employed was a single crusher or pair of splitting rollers and two mills 28 in. × 56 in., the bagasse from the second mill going to a diffusion battery, and thence to a third mill of the same size for crushing out the water before going to the boilers. The rate of milling was 394 tons in 24 hours and the cane crushed was Uba, containing 14 per cent. fibre, a comparison between 1921 before grooving and 1923 after grooving being given below:—

	1921 Before grooving. Per cent.	1923 After grooving. Per cent
Imbibition water, juice	17·5	17·5
Total sugar in cane	12·58	13·70
Extraction in crusher and mills	86·5	89·4
Total extraction mills and diffusion battery.	96·05	97·80
Sugar in bagasse after mills and diffusion battery — bagasse	1·63	1·10
Sugar in bagasse after mills and diffusion battery — cane	0·496	0·298

These figures show that an increase of 2·9 per cent. in the milling extraction was obtained after grooving. The opening at the feed side of the first mill before grooving was 1 in. and after grooving it was closed to ½ in., still milling at the usual rate. Thus, by using an opening of say ¾ in., an increase of milling capacity can be obtained, as well as an increased extraction.

Experiments were also carried out with increased imbibition, up to as much as 48 per cent., and also with no imbibition at all. In these two cases the extraction over the crusher and mills was 90·10 per cent. for 48 per cent. imbibition, and 88·10 per cent. for no imbibition, the total extraction over mills and diffusion battery remaining the same, namely, 97·8 per cent., as did also the loss in sugar in the bagasse after mills and diffusion battery. An interesting proof of the grip of the grooving was given by the mill crushing water from the bagasse after the diffusion battery. This bagasse arrives at the mill impregnated with water and skimmings, and is very slippery; but whereas before the installation of the Hinton-Marsden grooving "slip" very frequently occurred, now it goes through the mill quite smoothly.

Preliminary Estimate of the European Beet Sugar Crop of 1923-24.

(By Our Continental Correspondent.)

The Figures are Expressed in Metric Tons Raw Sugar Value.

Country.	Tons.	Country.	Tons.
Germany	1,400,000	Denmark	110,000
Czecho-Slovakia	900,000	Sweden	180,000
Austria	30,000	Yugo-Slavia	50,000
Hungary	100,000	Rumania	75,000
Poland	420,000	Bulgaria	15,000
Netherlands	330,000	Switzerland	6,000
Belgium	320,000	Great Britain	15,000
France	520,000		
Italy	330,000	Total (exclusive of Russia)	4,981,000
Spain	180,000		

Jinja (Uganda) White Sugar Factory.

A complete plant for the manufacture of plantation white sugar has recently been completed for shipment by Messrs. George Fletcher & Co., Ltd., of Derby, to the order of Messrs. Mathuradas Nanji & Co., and is now in course of erection at Jinja, Uganda. It has been designed for an output of one ton of plantation white sugar per hour. The milling plant comprises a crusher of the Krajewski type, with rollers 22 in. diam. × 48 in. long, and spring pressure regulation gear; and two 3-roller mills with rollers 26 in. diam. × 48 in. long fitted with hydraulic attachments on the top rollers, and the necessary hydraulic accumulators.

The intermediate carrier is arranged with fittings for macerating on the top and bottom of the blanket of crushed canes. The mills are driven by a horizontal engine with a steam cylinder 24 in. diam. × 42 in. stroke through compound steel gearing with an effective steam pressure of 70 lbs. per sq. in. The bagasse is delivered from the mill to boilers by carriers direct to the furnaces.

The clarification plant consists of juice heaters, liming and sulphuring tanks, subsiders and eliminators together with a sulphur burning apparatus complete. The scums are treated in "blow up" tanks and passed through filter-presses having a total filtering surface of 330 sq. ft.

The triple effect evaporator has a heating surface of 2750 sq. ft., and two vacuum pans with a heating surface of 345 sq. ft. each, with the necessary syrup and molasses tanks, and a central barometric condensing plant for the evaporator and vacuum pans worked by a dry air pump 18 in. diam. × 18 in. stroke with a steam cylinder of 11 in. diam. The injection water is delivered to the condenser by a centrifugal type pump having a capacity of 60,000 gallons per hour.

The curing department consists of six open type crystallizers; and a battery of six 30 in. belt-driven centrifugals with mixer, dry sugar carriers, and a revolving dryer.

The boiler installation consists of four multitubulars, 6 ft. 2 in. diam. × 15 ft. long, with furnaces for burning bagasse direct from the mill, the total heating surface being 6665 sq. ft. for a working pressure of 100 lbs. per sq. in.

Finally, the factory is complete with water service pumps, receivers, etc., housed in a steel framed building covered with corrugated sheeting, and is supplied with an efficient electric lighting plant.

Writing about his process of superheating cane juice before liming,[1] Mr. MAURICE BIRD remarks that there is now little doubt that by this means the restraining action of colloidal silica on the crystallization of sugar is largely if not wholly removed, the result being that the same machinery can do more work and turn out a better product with a saving of steam and a marked increase in the output of sugar.

In Hawaii there has been a good deal of discussion among practical planters as to whether the change from organic manures to chemical fertilizers would not in time work harm to the soils in the Territory, so during a recent visit to England, Mr. F. A. G. MUIR, at the request of Dr. AGEE, Director of the Experiment Station, submitted this question to Sir EDWARD J. RUSSELL, Director of the Rothamsted Experimental Station, who is probably the foremost authority on soil conditions and plant growth. Sir Edward's reply was to the effect that nothing was to be feared from the continued use of chemical fertilizers, as was shown by the Rothamsted experiments which have been carried on during the past 70 years; and that in every other land, and for every other crop, such methods had resulted only in a gradual increase in yields per acre, as well as in the permanent improvement of the productive capacity of the soil. Sir Edward paid a high tribute to agricultural practice in the T. H., stating that it is in line with the best and most advanced of the world.

[1] *I.S.J.* 1923, 44, 358.

Report on Mill Equipment in Hawaii.[1]

By W. v H. DUKER.

Revolving Knives.

A few years ago no season passed without a new type of knife being proposed. Lately very little has been said in this respect, and I think that at one time we over-estimated the benefit derived from cutting up the cane very finely, and have now gone back to the idea that the object is fulfilled if the knives are so arranged that they level the cane to assure an even feed.

Shredders.

Every now and then the question comes up as to whether or not the shredder is a successful part of the equipment. I have compiled a statement giving the results obtained in the seven factories equipped with shredders from 1914 on[2]; and in practically every instance either the capacity or the extraction, or both, show an increase. This does not necessarily mean that a shredder is a desirable feature in every mill, and experience has shown that unless the other equipment of the factory balances with that of the mill equipment no success can be expected.

Factory No. 6.

Crop.	Equipment.	Per Hour. Tons of Cane	Dilution.	Extraction.
1914	Knives; Crusher 72 in., 12 Roller Mill 78 in.	52·94	33·66	95·57
1915	Knives; Crusher 72 in., Shredder 54 in. (part of year), 12 Roller Mill 78 in.	53·76	35·98	97·32
1916	Knives; Crusher 72 in., Shredder 72 in., 12 Roller Mill 78 in.	55·6	40·27	97·73
1917	Knives (2); Crusher 78 in., Shredder 72 in., 12 Roller Mill 78 in.	59·6	35·18	98·56
1918	Knives (2); Crusher 78 in., Shredder 72 in., 12 Roller Mill 78 in.	55·37	39·18	98·47
1919	Knives (2); Crusher 78 in., Shredder 72 in., 12 Roller Mill 78 in.	48·25	50·64	98·99
1920	Knives (2); Crusher 78 in., Shredder 72 in., 12 Roller Mill 78 in.	58·08	43·93	98·92
1921	Knives (2); Crusher 78 in., Shredder 72 in., 19 Roller Mill 78 in.	67·27	36·6	99·07

Mills.

The following letter by Mr. Renton is instructive in showing that the Hind-Renton grooving after all has been responsible for the introduction of the deep grooving, now found in many mills as a means to facilitate feeding. "One steel feed roller, 34 ins. in diam., 1 in. pitch, 30° angle grooving, was installed in No. 4 mill as a feed roller on December 1st, 1914, and the crop started a week later. This roller has been in continuous use since that date and is now in use completing its eighth crop. It is now 32 ins. in diam. and will probably be scrapped this off-season. No. 4 mill is favourably situated, in that the blanket from No. 3 mill of the first mill train passes through long conveyors and is tumbled around considerably before being spread in front of No. 4 mill of the second mill

[1] Report of the Association of Hawaiian Sugar Technologists' First Annual Meeting, November, 1922.

[2] One set of figures only is here reproduced.

train. The No. 4 mill with the steel roller has never refused to feed even when returning a considerable quantity of No. 4 expressed juice in front of the fourth mill, as well as all of No. 5 expressed juice. . . . . Regarding the Hind-Renton grooving of which you make inquiry, I would say that in a measure it is still with us. In order to feed the necessary tonnage here at Ewa, we departed from the old ½ in. pitch standard to ⅝ in. pitch throughout. Later, the feed rollers were increased in pitch to ¾ in. with still better results in capacity. We are now going back to the fine grooving in top and back rolls, but retaining the ¾ in. pitch feed rolls as well as juice grooves in the feed and back rolls. I believe this last combination is being adopted by all factories grinding large tonnages of cane. The Hind-Renton grooving is responsible for the introduction of the coarse grooving."

There are still undesirable features in the present design of the mill cheeks, and particularly in the fact that only a small margin of roller wear is possible. Some years ago 33 in. diam. rollers were used, or recommended to take the place of the regular 32 in. rollers.

A new departure in intermediate carriers has been the introduction of the Meinecke chute, the construction of which is of course now known to every one. As far as I know, it has given full satisfaction wherever installed.

Our problem of disposing of the cush-cush, that is the coarser material, is still with us in the mills that have the old style mill beds, but the finer particles which come under the name of "suspended matter," are now receiving more and more attention, the general opinion now prevailing that it is these which cause so much stickiness and gumminess in the after-products.

Mr. H. C. WELLE, Chief Chemist for the California & Hawaiian Sugar Refinery Corporation, in a recent report on the qualities of raw sugars, writes: "Another phase that possibly may be of greater interest to the refiner is the probability that the extensive milling disintegrates the fibre of the cane to such a degree as to make it much more difficult to remove the so called "cush-cush" by means of screens, than would be the case with more moderate milling. It is purely surmise, but based on various definite observations, that this extremely finely divided solid material in suspension, when treated with lime at the high temperature of the tubular heaters, is changed or partially changed into a gummy material such as dextran. In most cases the low grade products were noted to be very gummy indeed, and it may be that this theory may partly account for such a fact."

A device designed by Mr. S. S. PECK[1] is now in operation in one of the factories on this island. Another screening device is the Carter Automatic Juice Strainer.[2]

HIGH EXTRACTION AND ACTUAL RECOVERY.

On several other occasions the question as to how much of the high extraction sugar actually gets into the bags and any definite data on this point are always taken up with considerable interest. The following is a report by J. LEWIS RENTON, mill superintendent at Ewa, on recent experiences there:—

There is considerable less difference in the purities between crusher juice and normal juice, mixed juice and syrup, in 1922 than in 1921 and 1919; 1921 may be considered an abnormal year, but 1919 is regarded as normal. We have about 15 per cent. less dilution on an average so far this season, and this may have some influence on the purities, but I am inclined to give most credit for the improvement to the cleaner conditions around the mill. That the differences in the figures during the 18-roller mill period this year are not larger than when grinding with a 9-roller mill is, in my opinion, in a great measure due to the new conveyors and juice pans, which can be kept clean easily.

[1] *I.S.J.*, 1921, 91, 155. [2] *I.S.J.*, 1921, 405.

	1922 9-Roller Mill.	1922 18-Roller Mill.	1921 18-Roller Mill.	1919 18-Roller Mill.
Apparent purity of Crusher juice ..	87·62 ..	86·56 ..	84·15 ..	86·30
Apparent purity of Normal juice ..	84·04 ..	83·36 ..	78·86 ..	81·83
Apparent purity of Mixed juice ..	84·70 ..	83·82 ..	79·37 ..	82·61
Apparent purity of Syrup	86·16 ..	85·19 ..	80·97 ..	84·28

The formula used to figure out the increased return in dollars of an 18-roller mill above what would have been received if operating as a 9-roller mill was:— $S = X\ Y - (A + B)$, in which S = increased return in dollars of 18-roller mill over 9-roller mill; X = tons of sugar recovered due to higher extraction; Y = dollars received per ton sugar; A = extra cost of manufacturing; and B = extra cost of marketing X tons of sugar.

From the above the following table was computed for varying prices of sugar and varying syrup purities, assuming 285,715 tons cane per crop; 14 per cent. sucrose in cane (about 13·7 polarization); 98 per cent. extraction with 18-roller mill; and 94 per cent. extraction with 9-roller mill.

Price Received for Sugar. Dollars per Ton.	PURITY OF THE SYRUP. 70°	75°	80°	85°	90°
$	$	$	$	$	$
110 ..	87,604 ..	94,315 ..	99,758 .	105,004 ..	109,339
100 ..	75,826 ..	81,640 ..	86,342 ..	90,886 ..	94,636
90 .	64,048 ..	68,965 ..	72,926 ..	76,768 ..	79,933
80 ..	52,270 ..	56,290 ..	59,510 ..	62,650 ..	65,230

During the 9-roller period, one crystallizer was filled for each 63·9 tons of sugar bagged; while during the 18-roller mill period, one crystallizer was filled for each 57 tons of sugar bagged. Also during the 9-roller mill period the evaporators were cleaner, requiring only one gang of five men for each Sunday, as compared to two or three gangs of five men each when running an 18-roller mill. He further reports that the boiling of both first and second sugars was easier during the 9-roller period. No noticeable change was observed in clarification on changing from a 9-roller to an 18-roller mill or in the mud press station.

The gravity purity of the waste molasses was the same in both cases, namely 37·12. The tons of waste molasses per ton sucrose in sugar for the 9-roller mill period was 0·255 and for the 19-roller mill 0·236. This slight difference may be an error in estimating molasses in stock.

	9-Roller Period.	19-Roller Period.
Theoretical boiling house recovery[1]	91·85 ..	91·28
Extraction	94 07 ..	97·98
Actual boiling house recovery	91·70 ..	92·05
Total recovery	86·26 ..	90·19
Gain in extraction	.. ..	3·91
Gain in total recovery..	.. ..	3·93

A. Reisenleitner[2] states that the colouring matter of the wild carrot is a very sensitive indicator for use in acidimetric titrations. It is blood red in acid solution, and deep green in alkaline solution, the colour change being instant and unmistakable. It is suitable for the titration of organic acids.

[1] Sugar purities were equalized (98·62). Molasses purities happened to be alike, so that the difference of 0·57 is due *only* to difference in syrup purities. This 0 57 is added to the actual boiling house recovery in the 18-roller period to make the figures comparable with the 9-roller period.

[2] *Chemiker Zeitung*, August 11th, 1923.

Table for determining the Sugar Content of Bagasse, using Spencer's Rotary Digester or a Reflux Condenser.

By A. H. ALLEN, Fajardo Sugar Co., Porto Rico.

Spencer's Rotary Digestion Method.

In Spencer's rotary digestion method[1] the sample of bagasse, together with the required amount of water, is introduced into a closed container and rotated slowly in a bath of hot water. The capsule or container is made of sufficient size to allow of the contents falling from end to end, as it is rotated, thus facilitating maceration and diffusion. This principle is scientifically correct, and it is probable that the method is the very best yet devised for the extraction of the sucrose utilizing the single digestion method. From the weight of the extract and the sugar therein, the sugar in the bagasse is easily calculated.

The ordinary method requires weighing the sample of bagasse, and also, at the end of the digestion, the container and contents. From the weights of the sample and the extract, the percentage of sugar is calculated, as illustrated in the following example, in which the fibre in the bagasse is taken to be 47·0 per cent.:—

	Grms.
Weight of the bagasse	100·00
Weight of the capsule plus bagasse and water	928·00
Weight of container	292·00
Weight of bagasse and water	636·00
Weight of fibre in bagasse	47·00
Weight of liquid	589·00

Polarization of the liquid by Horne's dry lead acetate method, reading in a 400 mm. tube = 6·0; in a 200 mm. tube = 3·0; and corresponding per cent. of sugar by Schmitz' table, 0·77. Then the per cent. sugar is: $589 \times 0·0077 \times 100$; and this divided by 100 = 4·54.

The analysis as performed in this way requires weighing the capsule, and weighing the container and contents at the end of the digestion. The container itself need not be weighed but occasionally, and in deducting from the weight of the container and contents, this weight may be used over and over again until it is found to have changed. A small difference in weight makes practically no difference in the results.

Modification, obviating Weighing after Digestion.

It is much easier, however, to conduct the analysis without the necessity of weighing the digester and contents at the end of the digestion. This is accomplished by measuring a given weight of water into the container from a burette. The table below is devised for this method, which is operated as follows:—100grms. of the sample are introduced into the digestion cylinder after weighing in a suitable capsule; 500 grms. of water are added by measuring the required volume from a 500 c.c. Morse calibrating burette; and also 5 grms. (4·9 c.c.) of a 5 per cent. solution of sodium carbonate; digestion is continued for 50 mins., and at the completion of this time the container is cooled to room temperature, usually taking less than 10 mins. This allows of an analysis in one hour's time.

[1] *I.S.J.*, 1921, 630.

Operation, using a Reflux Condenser.

In lieu of a rotary digestion apparatus, a flask with a reflux condenser may be used, or a copper cylinder provided with a brass ring around the top edge and a circular cover made of brass plate. The joint between the ring and the cover should be ground, and if thought necessary, the cover may be held firmly to the ring with suitable clamps. To the cover is attached a piece of brass tubing of ¼ in. diam., and not less than 12 in. long. A brass rod slightly smaller in diameter than the brass tube, and provided with a small disc for stirring, is passed through this brass tube. Occasionally the contents of the digester are agitated with the stirrer in order to promote diffusion. The apparatus should be heated by a water-bath, as boiling too hard (the likely result of heating in other ways) would cause a dilution error. No water should be added after the original amount of water is introduced, under which conditions the volume of liquid, for all practical purposes, remains constant.

The cover may be provided for connexion to a water-cooled condenser, using a short piece of heavy rubber tubing for making the joint between the short brass tube and the condenser.

Calculation and Use of Table.

In any case, the table serves for determining the per cent. sugar in the bagasse, providing the conditions outlined are followed, and no water is added during digestion or subsequent thereto. The table, divided into three parts for convenience, is calculated from the weight of the extract and the percentage of sugar in the extract by Horne's dry lead acetate method, taking into consideration the purity of the thin-juice which is assumed to vary evenly from 68·0 to 75·5. When the sugar in bagasse is as low as 1·0 per cent., the thin juice will be found to possess a purity of about 68·0; and when the sugar in the bagasse is very high, the purity of the thin-juice will rise considerably. In the upper limits of the table the purity of the thin-juice will rise to about 75·5. The polarization is divided by the factor 3·838 to obtain the approximate percentage of sugar; this in turn is divided by the corresponding purity of the thin-juice to obtain the Brix, which, in conjunction with the polarization from Schmitz' table, gives the correct percentage of sugar. Little differences in Brix are of no magnitude until percentages of 6 per cent. and over of sugar in bagasse are reached. In using the Schmitz' table the observed polarization is reduced to that of a 200 mm. tube and the table for undiluted solutions is used.

That part of the table having a range up to 5·5 per cent. sugar will be found to cover most ordinary samples; while that having a range up to 10·5 per cent. sugar serves for analysis of bagasse issuing from the first two tandems of the milling unit. Milling control tends toward figuring extractions on each set of the milling tandem, so that the table should cover any range likely to be encountered except, perhaps, an exceptional case where very high sucrose cane is being milled. It also provides for bagasse of any fibre content usually obtained.

It is to be noted that the weight of the extract is considerable, varying from 551 grms. to 567 grms., and as Schmitz' table is interpolated only to 1/100ths., the variation in the percentage of sugar by the table might reach 0·06 per cent. from the average; that is, if the average difference is 0·10 per cent. for each 1/10th. degree polarization, the maximum difference in the table could reach 0·10 plus 0·06 (up and down) or 0·22. To obviate this (and it is correct to do so) the table is calculated making a constant difference for each degree polarization.

It is thought that this table will be found convenient for use in connexion with the best and most approved method of bagasse analysis.

TABLE FOR DETERMINING PER CENT. SUGAR IN BAGASSE.
(TAKING 100 GRMS. SAMPLE; 500 GRMS. WATER; 5 GRMS. (4·9 C.C.) OF A 5 PER CENT. SOLUTION OF SODIUM CARBONATE; AND READING IN A 400 MM. TUBE.)

POL. 400 MM TUBE	FIBRE PER CENT. BAGASSE.								
	38·0	40·0	42·0	44·0	46·0	48·0	50·0	52·0	54·0
1·0	0·68	0·68	0·68	0·67	0·67	0·67	0·67	0·66	0·66
·1	0·76	0·76	0·75	0·75	0·75	0·75	0·74	0·74	0·74
·2	0·84	0·84	0·83	0·83	0·83	0·82	0·82	0·82	0·82
·3	0·92	0·92	0·91	0·91	0·91	0·90	0·90	0·90	0·89
·4	1·00	0·99	0·99	0·99	0·98	0·98	0·98	0·97	0·97
·5	1·08	1·07	1·07	1·07	1·06	1·06	1·06	1·05	1·05
·6	1·16	1·15	1·15	1·14	1·14	1·13	1·13	1·13	1·12
·7	1·24	1·23	1·23	1·22	1·22	1·21	1·21	1·21	1·20
·8	1·32	1·31	1·31	1·30	1·30	1·29	1·29	1·28	1·28
·9	1·39	1·39	1·38	1·38	1·38	1·37	1·37	1·36	1·36
2·0	1·47	1·47	1·46	1·46	1·45	1·45	1·44	1·44	1·43
·1	1·55	1·54	1·54	1·53	1·53	1·52	1·52	1·51	1·51
·2	1·62	1·62	1·61	1·60	1·60	1·59	1·59	1·58	1·58
·3	1·70	1·69	1·68	1·68	1·67	1·67	1·66	1·65	1·65
·4	1·77	1·76	1·76	1·75	1·74	1·74	1·73	1·73	1·72
·5	1·84	1·83	1·82	1·82	1·81	1·80	1·80	1·79	1·79
·6	1·92	1·91	1·90	1·90	1·89	1·88	1·88	1·87	1·86
·7	1·99	1·98	1·98	1·97	1·96	1·96	1·95	1·94	1·93
·8	2·06	2·06	2·05	2·04	2·03	2·03	2·02	2·01	2·01
·9	2·14	2·13	2·12	2·11	2·11	2·10	2·09	2·09	2·08
3·0	2·21	2·20	2·20	2·19	2·18	2·17	2·16	2·16	2·15
·1	2·29	2·28	2·27	2·26	2·25	2·24	2·24	2·23	2·22
·2	2·36	2·35	2·34	2·33	2·33	2·32	2·31	2·30	2·29
·3	2·43	2·42	2·42	2·41	2·40	2·39	2·38	2·37	2·36
·4	2·51	2·50	2·49	2·48	2·47	2·46	2·45	2·44	2·44
·5	2·58	2·57	2·56	2·55	2·54	2·53	2·53	2·52	2·51
·6	2·65	2·64	2·63	2·63	2·62	2·61	2·60	2·59	2·58
·7	2·73	2·72	2·71	2·70	2·69	2·68	2·67	2·66	2·65
·8	2·80	2·79	2·78	2·77	2·76	2·75	2·74	2·73	2·72
·9	2·87	2·86	2·85	2·84	2·83	2·82	2·81	2·80	2·79
4·0	2·95	2·94	2·92	2·91	2·90	2·89	2·88	2·87	2·85
·1	3·02	3·01	3·00	2·99	2·98	2·97	2·96	2·95	2·94
·2	3·10	3·08	3·07	3·06	3·05	3·04	3·03	3·02	3·01
·3	3·17	3·16	3·15	3·14	3·12	3·11	3·10	3·09	3·08
·4	3·24	3·23	3·22	3·21	3·20	3·19	3·17	3·16	3·15
·5	3·32	3·31	3·29	3·28	3·27	3·26	3·25	3·24	3·22
·6	3·39	3·38	3·37	3·35	3·34	3·33	3·32	3·31	3·29
·7	3·46	3·45	3·44	3·43	3·42	3·40	3·39	3·38	3·37
·8	3·54	3·53	3·51	3·50	3·49	3·48	3·46	3·45	3·44
·9	3·61	3·60	3·59	3·57	3·56	3·55	3·54	3·52	3·51
5·0	3·69	3·67	3·66	3·65	3·63	3·62	3·61	3·59	3·58
·1	3·76	3·75	3·73	3·72	3·71	3·69	3·68	3·67	3·65
·2	3·83	3·82	3·81	3·79	3·78	3·77	3·75	3·74	3·72
·3	3·91	3·89	3·88	3·87	3·85	3·84	3·82	3·81	3·80
·4	3·98	3·97	3·95	3·94	3·92	3·91	3·90	3·88	3·87
·5	4·05	4·04	4·03	4·01	4·00	3·98	3·97	3·95	3·94
·6	4·13	4·11	4·10	4·08	4·07	4·05	4·04	4·03	4·01
·7	4·20	4·19	4·17	4·16	4·14	4·13	4·11	4·10	4·08
·8	4·28	4·26	4·25	4·23	4·21	4·20	4·18	4·17	4·15
·9	4·35	4·33	4·32	4·30	4·29	4·27	4·26	4·24	4·23

Table for Determining the Sugar Content of Bagasse.

Pol. 400 mm. Tube.	Fibre per cent. Bagasse.								
	38·0	40·0	42·0	44·0	46·0	48·0	50·0	52·0	54·0
6·0	4·42	4·41	4·39	4·38	4·36	4·34	4·33	4·31	4·30
·1	4·50	4·48	4·46	4·45	4·43	4·42	4·40	4·39	4·37
·2	4·57	4·55	4·54	4·52	4·51	4·49	4·47	4·46	4·44
·3	4·64	4·63	4·61	4·59	4·58	4·56	4·55	4·53	4·51
·4	4·72	4·70	4·68	4·67	4·65	4·63	4·62	4·60	4·58
·5	4·79	4·77	4·76	4·74	4·72	4·71	4·69	4·67	4·66
·6	4·86	4·85	4·83	4·81	4·80	4·78	4·76	4·74	4·73
·7	4·94	4·92	4·90	4·89	4·87	4·85	4·83	4·82	4·80
·8	5·01	4·99	4·98	4·96	4·94	4·92	4·91	4·89	4·87
·9	5·09	5·07	5·05	5·03	5·01	5·00	4·98	4·96	4·94
7·0	5·16	5·14	5·12	5·11	5·09	5·07	5·05	5·03	5·01
·1	5·23	5·21	5·20	5·18	5·16	5·14	5·12	5·10	5·09
·2	5·31	5·29	5·27	5·25	5·23	5·21	5·19	5·18	5·16
·3	5·38	5·36	5·34	5·32	5·30	5·29	5·27	5·25	5·23
·4	5·45	5·44	5·42	5·40	5·38	5·36	5·34	5·32	5·30
·5	5·53	5·51	5·48	5·47	5·45	5·43	5·41	5·39	5·37
·6	5·60	5·58	5·56	5·54	5·52	5·50	5·48	5·46	5·44
·7	5·68	5·66	5·64	5·62	5·60	5·58	5·56	5·54	5·52
·8	5·75	5·73	5·71	5·69	5·67	5·65	5·63	5·61	5·59
·9	5·82	5·80	5·78	5·76	5·74	5·72	5·70	5·68	5·66
8·0	5·90	5·88	5·86	5·83	5·81	5·79	5·77	5·75	5·73
·1	5·97	5·95	5·93	5·90	5·88	5·86	5·84	5·82	5·80
·2	6·04	6·02	6·00	5·97	5·95	5·93	5·91	5·89	5·87
·3	6·11	6·09	6·07	6·04	6·02	6·00	5·98	5·96	5·94
·4	6·18	6·16	6·14	6·11	6·09	6·07	6·05	6·03	6·01
8·5	6·25	6·23	6·21	6·19	6·16	6·14	6·12	6·10	6·07
·6	6·32	6·30	6·28	6·26	6·23	6·21	6·19	6·17	6·14
·7	6·39	6·37	6·35	6·33	6·30	6·28	6·26	6·24	6·21
·8	6·46	6·44	6·42	6·40	6·37	6·35	6·33	6·30	6·28
·9	6·53	6·51	6·49	6·47	6·44	6·42	6·40	6·37	6·35
9·0	6·61	6·58	6·56	6·54	6·51	6·49	6·47	6·44	6·42
·1	6·68	6·65	6·63	6·61	6·58	6·56	6·54	6·51	6·49
·2	6·75	6·72	6·70	6·68	6·65	6·63	6·60	6·58	6·56
·3	6·82	6·79	6·77	6·75	6·72	6·70	6·67	6·65	6·63
·4	6·89	6·86	6·84	6·82	6·79	6·77	6·74	6·72	6·69
·5	6·96	6·94	6·91	6·89	6·86	6·84	6·81	6·79	6·76
·6	7·03	7·01	6·98	6·96	6·93	6·91	6·88	6·86	6·83
·7	7·10	7·08	7·05	7·03	7·00	6·98	6·95	6·93	6·90
·8	7·17	7·15	7·13	7·10	7·07	7·05	7·02	7·00	6·97
·9	7·24	7·22	7·19	7·17	7·14	7·12	7·09	7·06	7·04
10·0	7·31	7·29	7·26	7·24	7·21	7·19	7·16	7·13	7·11
·1	7·39	7·36	7·34	7·31	7·28	7·26	7·23	7·21	7·18
·2	7·46	7·44	7·41	7·38	7·36	7·33	7·30	7·28	7·25
·3	7·54	7·51	7·48	7·46	7·43	7·40	7·38	7·35	7·32
·4	7·61	7·58	7·56	7·53	7·50	7·47	7·45	7·42	7·39
·5	7·68	7·66	7·63	7·60	7·57	7·55	7·52	7 49	7·47
·6	7·76	7·73	7·70	7·67	7·65	7·62	7·59	7·57	7·54
·7	7·83	7·80	7·78	7·75	7·72	7·69	7·66	7·64	7·61
·8	7·90	7·88	7·85	7·82	7·79	7·76	7·74	7·71	7·68
·9	7·98	7·95	7·92	7·89	7·87	7·84	7·81	7·78	7·75

FIBRE PER CENT. BAGASSE.

POL. 400 MM. TUBE.	38·0	40·0	42·0	44·0	46·0	48·0	50·0	52·0	54·0
11·0	8·05	8·02	7·99	7·97	7·94	7·91	7·88	7·85	7·82
·1	8·13	8·10	8·07	8·04	8·01	7·98	7·95	7·92	7·90
·2	8·20	8·17	8·14	8·11	8·08	8·05	8·03	8·00	7·97
·3	8·27	8·24	8·21	8·18	8·16	8·13	8·10	8·07	8·04
·4	8·35	8·32	8·29	8·26	8·23	8·20	8·17	8·14	8·11
·5	8·42	8·39	8·36	8·33	8·30	8·27	8·24	8·21	8·18
·6	8·49	8·46	8·43	8·40	8·37	8·34	8·31	8·28	8·25
·7	8·57	8·54	8·51	8·48	8·45	8·42	8·39	8·36	8·33
·8	8·64	8·61	8 58	8 55	8·52	8·49	8·46	8·43	8·40
·9	8·71	8·68	8·65	8·62	8·59	8·56	8·53	8·50	8·47
12·0	8·79	8·76	8·73	8·70	8·66	8·63	8·60	8·57	8·54
·1	8·86	8·83	8·80	8·77	8·74	8·71	8·67	8·64	8·61
·2	8·93	8·90	8·87	8·84	8·81	8·78	8·75	8·72	8·68
·3	9·01	8·98	8·95	8·91	8·88	8·85	8·82	8·79	8·76
·4	9·08	9·05	9·02	8·99	8·96	8·92	8·89	8·86	8·83
·5	9·16	9·12	9·09	9·06	9·03	9·00	8·96	8·93	8·90
·6	9·23	9·20	9·17	9·13	9·10	9·07	9·04	9·00	8·97
·7	9·30	9·27	9·24	9·21	9·17	9·14	9·11	9·07	9·04
·8	9·38	9·35	9·31	9·28	9·25	9·21	9·18	9·15	9·11
·9	9·45	9·42	9·39	9·35	9·32	9·29	9·25	9·22	9·19
13·0	9·53	9·49	9·46	9·92	9·39	9·36	9·32	9·29	9·26
·1	9·60	9·57	9·53	9·50	9·46	9·43	9·40	9·36	9·33
·2	9·67	9·64	9·60	9·57	9·54	9·50	9·47	9·43	9·40
·3	9·75	9·71	9·68	9·64	9·61	9·57	9·54	9·51	9·47
·4	9·82	9·79	9·75	9·72	9·68	9·65	9·61	9·58	9·54
·5	9·89	9·86	9·82	9·79	9·75	9·72	9·68	9·65	9·61
·6	9·97	9·93	9·90	9·86	9·83	9·79	9·76	9·72	9·69
·7	10·04	10·01	9·97	9·94	9·90	9·86	9·83	9·79	9·76
·8	10·12	10·08	10·04	10·01	9·97	9·94	9·90	9·87	9·83
·9	10·19	10·15	10·12	10·08	10·05	10·01	9·97	9·94	9·90
14·0	10·26	10·23	10·19	10·15	10·12	10·08	10·05	10·01	9·97
·1	10·33	10·30	10·26	10·22	10·19	10·15	10·11	10·08	10·04
·2	10·40	10·37	10·33	10·29	10·26	10·22	10·18	10·15	10·11
·3	10·48	10·44	10·40	10·36	10·33	10·29	10·25	10·22	10·18
·4	10·55	10·51	10·47	10·43	10·40	10·36	10·32	10·29	10·25
·5	10·62	10·58	10·54	10·50	10·47	10·43	10·39	10·35	10·32
·6	10·69	10·65	10·61	10·57	10·54	10·50	10·46	10·42	10·39
·7	10·76	10·72	10·68	10·64	10·61	10·57	10·53	10·49	10·46
·8	10·83	10·79	10·75	10·72	10·68	10·64	10·60	10·56	10·52
·9	10·90	10·86	10·82	10·79	10·75	10·71	10·67	10·63	10·59
15·0	10·97	10·93	10·89	10·86	10·82	10·78	10·74	10·70	10·66
·1	11·04	11·00	10·96	10·93	10·89	10·85	10·81	10·77	10·73
·2	11·11	11·07	11·03	11·00	10·96	10·92	10·88	10·84	10·80
·3	11·18	11·14	11·11	11·07	11·03	10·99	10·95	10·91	10·87
·4	11·25	11·22	11·18	11·14	11·10	11·06	11·02	10·98	10·94
·5	11·33	11·29	11·25	11·21	11·17	11·13	11·09	11·05	11·01
·6	11·40	11·36	11·32	11·28	11·24	11·20	11·16	11·12	11·08
·7	11·47	11·43	11·39	11·35	11·31	11·27	11·22	11·18	11·14
·8	11·54	11·50	11·46	11·42	11·38	11·33	11·29	11·25	11·21
·9	11·61	11·57	11·53	11·49	11·45	11·40	11·36	11·32	11·28

Experience in Java with Mixtures of Bagasse and Trash as Fuel.

At the annual meeting of technical advisers of the principal Java sugar companies, experience with the use of mixtures of bagasse and trash was discussed, and the more important points emerging in this discussion are briefly given here.

In latter years Java factories have gone in for the burning of dry cane trash in the furnaces to a much larger extent than before. Whereas formerly the dry trash was used in the condition in which it was hauled from the field, it was soon found much more economical to cut it up into small pieces for mixing with the bagasse before being carried to the furnace.

Some factories imported machines used in Europe for cutting straw, but it appeared that they were much too weak to handle the hard cane leaves, and had therefore to be discarded. A better implement was found in the "Globatoscutter"; but this too proved insufficient to cut up all the dirty and sandy cane trash from the fields of the factory during the entire grinding season. When the cutter is working well, it makes 500 revolutions per minute, and consumes 6 to 8 h.p.; but the knives very rapidly get blunt, and the steam power necessary to divide a sufficient amount of trash becomes much larger.

If the proportion of cane tops among the trash is small, they are cut up together with the trash and burn very well in the furnace, but as soon as their quantity becomes larger, the machine will not take them properly and ultimately stops.

It was, however, found that the mixing of finely divided trash with bagasse was a great advantage, since the mixture burns much better than bagasse alone, owing to its greatly reduced water content. So it was found possible to burn a bagasse of 54 per cent. of moisture after it had been mixed with a proper amount of cut-up trash. The bagasse is rendered more porous by the mixing, so that it dries better before the grate and yields a loose ash, while the proportion of unburnt matter is greatly reduced.

It was observed when firing with a bagasse of 48 per cent. of moisture that the steam pressure decreased as soon as the trash cutter stopped, but that twenty minutes after it had been set to work again the pressure again rose to the required figure.

For this reason Mr. Held found it worth while to try and construct a better trash-divider than the cutters already in use. His machine is constructed somewhat after the principle of the Searby shredder, and although its work is better than that of the former machines, the inventor is not yet entirely satisfied, but is determined to overcome the difficulties still unsolved. Other experimenters tried Krajewski shredders for dividing the trash. One was not satisfied, as at times when the feed was poor the trash was only squeezed and not broken, while another found he could easily handle 100 tons of dry trash per twenty-four hours by one single crusher. The divided trash was blown to the furnaces by a pneumatic installation.

The cost of carrying the trash to the factory is calculated at 10 guilder cents per picul, or 2s. 8d. per ton, while the expense of cutting it up and carrying it to the furnace may be assumed to be another 10 cents. Therefore the dry fuel costs 5s. 4d. per ton.

Deterioration of Cut Cane, Juices, Press Cake, Syrups and Massecuites.[1]

By W. K. ORTH.

Cut Cane.

Records are kept at Ewa of the purities, and lately also of the quality ratios, of all first expressed juices, which results are tabulated according to the number of days after burning the cane is ground. In the following table are shown the average purities of all juices of the first to the eighth day after burning, regardless of the individual fields from which they came:—

	1st day.	2nd day.	3rd day.	4th day.	5th day.	6th day.	7th day.	8th day.
January	85·6	85·0	84·7	84·3	84·2	84·6	83·4	83·4
February	84·9	85 9	85·1	84·7	83·1	82·6	81·5	81·4
March	87·4	87·3	85·8	84·9	84·4	84·5	82·1	80·7
April	88·8	88·8	88·6	88·7	86·8	—	—	—
May	88·8	88·0	87·6	87·5	86·7	—	—	—
June	88·0	86·9	86·6	86·2	85·3	84·8	—	—
July	86·2	85·3	84·0	85·1	84·4	85·1	83·9	—
Average	86·66	86·99	86·36	85·80	84·28	84·08	82·50	80 70
Drop in Purity		0·33	—0·30	—0·86	—2·38	—2·58	—4·16	—5·96
No. of Samples	152	181	209	177	136	66	48	16

These figures do not require much comment; they show nothing new, but their wide range should make them valuable. They again point to the necessity of putting burnt cane through the mill as soon as possible.

A breakdown stopped the mill a; Ewa for four days, with cane that had passed the first set of knives on the carrier, while the yard was well filled with cane on cars, and there was a cut supply in the fields. When grinding was resumed, the juice from the cane on the carrier had spoiled so much that it could not be clarified for analysis. The cane on the cars had apparently kept better than the cane in the field. The last juice of a certain field ground on the day of the breakdown had 85·5° purity; the cane on the cars during the first day of grinding again 85·0°; and the cane in the field 83·6°. The latter was then perhaps one-half to one day older than the cane on the cars.

Mill Juices.

Crusher Juice.—Three tests of five hours' duration did not show any deterioration during the first three, and only a very slight drop in purity at the end of the fifth hour. The initial purities ranged from 81·2 to 78·8 and after five hours from 81·2 to 78·2. No preservatives were used.

Last Mill Juice.—Five tests on the last mill juice of 2·5° Brix showed about an average drop in purity during the first half-hour of 1·9, at the end of the first hour 5·0, and at the end of the fifth hour 7·2, no preservative being employed. With four drops of formalin per gallon, the figures were 0·5, 0·7, 3·7 respectively, indicating the necessity of a preservative and of the frequent sampling of last mill juices.

Mixed Juice.—Mr. H. S. WALKER, of Pioneer Mill Company, wrote:— "Samples of mixed juice from the mill tank, kept in the laboratory in covered buckets, ordinarily lost from 0 to 0·2 polarization reading (dry lead method) in one hour. Samples of the first juice entering the scale tank on starting up the

[1] Reports of the Association of Hawaiian Sugar Technologists, First Annual Meeting, November, 1922.

mill, after several hours' shut down, lost from 0·2 to 0·5 in reading during the first hour and deteriorated a little more rapidly on standing longer. When the mill was washed down thoroughly and the mixed juice line flushed out with water just before starting up, the first runnings showed less tendency to deteriorate."

To trace the influence of cleanliness (or the lack of it) on the keeping qualities of juices, experiments were made at Ewa. One portion of the juice samples *B*, five gallons to start with, was infected with a small handful of cush-cush that had collected below the third mill rollers and was strongly sour; while the other portion *A* was not so treated.

	At Once.	½ Hr.	1 Hr.	1½ Hrs.	2 Hrs.	2½ Hrs.	3½ Hrs.	4 Hrs.
Purity of sample *A*	80·42	80·42	80·52	80·52	80·32	80·22	79·90	79·75
Difference in Purity	—	—	+0·10	+0·10	-0·10	-0·20	-0·52	-0·67
Purity of sample *B*	80·42	80·42	79·72	79·42	79·12	78·72	78·35	73·75
Difference in purity	—	—	-0·70	-1·00	-1·30	-1·70	-2·07	-6·67

In these tests the glucose did not increase but remained for four hours at 1·45 per cent. To test the possible argument that a destruction of sucrose might not be shown by figures based on polarization, on account of glucose being at first more actively fermented by zymase, and the sucrose later inverted by invertase, a number of sucrose determinations by Clerget were run. The results obtained indicated this not to be the case, and seemed indeed to show that no great deterioration takes place during the time the juice is in transit to the heaters.

However, this does not change our conviction that the greatest cleanliness around the mills is essential for highest recovery. The effect of the infection by sour cush-cush or fermented juice may not be strong enough to destroy sucrose in the inoculated juice during the short time of half an hour, yet the quantity of badly deteriorated material accumulating on the old apron conveyers and in the crevices and corners of some mills, which material from time to time is washed into the juice, is enough to lower appreciably the purity of the mixed juice below that what it should be. This we shall try to demonstrate by figures taken from records at Ewa.

During fifteen weeks' grinding, with nine-roller mill, with reduced chance of souring, the average differences between crusher and mixed juice were :—

Mondays	2·75
Tuesdays	2·75

But during 20 weeks following, grinding with 18 rolls, these were :—

Mondays	4 16
Tuesdays	4·53

This result caused us to wash down the mill whenever we had a chance to do so, and on quite a number of days we stopped the mill purposely to clean it with hot water. On such days the crusher-mixed juice difference was 2·07. On other days it was 3·07, which was the average of twenty-five samples.

At Ewa conditions have been severer than in many other places, the protracted grinding seasons of late years having prevented the mills being brought fully up-to-date in regard to cleanliness. That a step has been made in the right direction, by the installation of two Meinecke conveyors and more self-cleaning juice trays, is shown by the fall of the difference between crusher and mixed juice, during the time that our mill was thus equipped during the past season. While previously the difference was 4·78 (1921), 4·28 (1920), 3·65 (1919), it is now 2·80 with the same eighteen roller mill and about the same extraction.

HOT JUICES IN SETTLING TANKS.

With regard to preservation of mixed juice by means of either formalin, soda ash, or mercuric chloride, Mr. V. P. IYER, of Paauilo, furnishes us with the results of carefully conducted experiments. The outcome is that formalin proved the most reliable, and soda ash, in combination or without lime, the least satisfactory.

Mr. H. S. WALKER reports the following under this heading: "Frequent stoppage for lack of cane in 1921 gave us an opportunity for us to check up on deterioration in the settling tanks. An average of 207 analyses representing 207 tanks, held on the average for 11·903 hours per tank, showed a loss in purity of 0·313°. We still follow the system outlined several years ago[1] of heating only to 180°F. that juice which is to be held in the settling tanks for more than an hour or so. When running steadily we average about 200°F. in the settling tanks, as a much lower temperature seems to retard settling. The old researches of HERZFELD on the decomposition of very slightly alkaline sucrose solutions are worth remembering in this connexion. The amount of sucrose decomposed per cent. on that originally present or, very roughly, the drop in purity, per hour in a 10 per cent. sugar solution was at:

170°F.	0·0444
194°F.	0·0790
212°F.	0·1140

"Taking 176°F. as the average temperature of juice held over at Pioneer, we would expect then a loss in sucrose in 12 hours of 0·53 per cent. of the total. Our actual average loss in purity on 207 samples was, as reported above, 0·31 per cent. . . . Deterioration of juice in settling tanks may be caused by bacterial action, by the effect of heat, or by both these agencies together. From 212°F. down to about 160°F., decomposition is brought about by heat, and is much less at the lower temperatures. Below 160° thermophilic bacteria may function, producing an acid which inverts sucrose. Losses may be minimized by liming juice which is to be stored to a decided phenolphthalein alkalinity, heating only to a temperature high enough to prevent cooling below 160° during storage, and storing in well insulated and covered tanks. It is possible that re-infection of partially cooled juice in uncovered tanks may do more damage than the bacteria originally present. . . . . . ."

At Ewa, the present author planned some "Thermos" bottle experiments to test the different preservatives and the effect of heat at the same time. Quart bottles were used. The time for incubation being 28½ hours.

	TREATMENT.	PURITY.
	Mixed juice content test	79·2
A.	Slightly alkaline to litmus, in 212°F., out 144°F.	77·2
B.	As *A* + formalin 1 part in 3800, in 212°F., out 144°F.	77·2
C.	As *A* + 1 grm. Na_2CO_3 in 1 qt. of juice, in 212°F., out 152°F.	77·2
D.	As *A*, in 185°F., out 140°F.	77·2
E.	As *B*, in 185°F., out 140°F.	77·2
F.	As *C*, in 185°F., out 138°F.	77·2

Hence there was no appreciable effect due to variations in temperature or preservatives.

Two portions of mixed juice, *A* and *B*, were limed to barely blue on red litmus paper, in the following experiment.

[1] *I.S.J.*, 1919, 611; also 1922, 154.

Deterioration of Cut Cane, Juices, Press Cake, Syrups and Massecuites.

	Temperature.	Purity.		Drop after 2½ Hours.
A.	In 180°F.	80·1	....	—
	Out 171°F.	79·8	....	0·3
B.	In 212°F.	80·65	....	—
	Out 190°F.	80·1	....	0·55

If heat is responsible for the difference in purity drop, the increase with higher temperature is somewhat in the proportion given by Herzfeld.

In the next experiment mixed juice was limed slightly alkaline to litmus when cold, no preservative being added.

	Temperature.	Purity.		Drop after 4½ Hours.
A.	In 180°F.	77·8	....	—
	Out 163°F.	77·15	....	0·65
B.	In 212°F.	77·65	....	—
	Out 192°F.	78 2	..	+0·55

To test the effect of heavy liming and heat, mixed juice was limed distinctly alkaline to phenolphthalein when cold, when approximately the same result was obtained. An increase in purity with the higher temperature and heavier liming applied in these tests may be due to the destruction of glucose.

A few tank experiments were carried out with mixed juice heavily limed without the use of preservative, and the following results were obtained:—

	Temperature.	Purity.		Drop after 28 Hours.
A.	In 185°F.	83 3	...	—
	Out 148°F.	80·6	....	2·7
B.	In 184°F.	82·3	....	—
	Out 159°F.	79·7	....	2·6
C.	In 185°F.	82·3	....	—
	Out 162°F.	81·1	...	1·2

Mixed juice, limed neutral to litmus plus formalin one part in 5000, was put in at 180°F. and taken out at 148°F. The purity of the juice at the beginning was 81·5 and after twenty-eight hours, it was 74·6, showing a drop of 6·9.

At Ewa we heat the juice to be kept in tanks to 212°F. in order to be sure that the temperature does not sink below 160°F. As preservatives, we over-lime and add formalin, one part in 3000. It appears to us that in our case it is more important to prevent the juice from cooling below 160°F. than to try avoiding the effect of the higher temperature on sucrose.

Press Cake.

It seems reasonable to expect that, if deterioration has started in the mud-presses, the polarization of the discharged mud should continue to go back during the first hour or so. But a number of tests made at Ewa showed no drop in polarization during the first two hours. Apparently then no appreciable deterioration in mud-presses needs to be feared if no large storage tanks are used, if the settlings are kept hot and alkaline, and only the hottest water available is used for sweetening off. These are the precautions that were taken during the experiments. If sweetening off is unduly prolonged, it may be advisable to keep the water also alkaline. We did notice that when water was kept in longer than three hours it had a tendency to run acid. Extremely low polarization of the mud is in such cases most probably due to inversion.

Syrups and Massecuites.

It is generally accepted that deterioration in the sense of destruction of sucrose does not take place in these products under ordinary circumstances, provided they are not allowed to become distinctly acid. If the difference between

gravity purity and apparent purity in mixed juice and the syrup coming from it is an indication, a slight destruction of glucose is shown in our factory, where the difference for mixed juice is 1·02 and for syrup 0·89.

Tests show that no deterioration went on in the crystallizers, glucose: polarization ratios, established for seven crystallizers from day to day at different times of the season, remaining without change for as long as fourteen days. A few short runs on massecuites stored in tanks, however, gave us reason to suspect deterioration there.

Determination of the Potash in Cane Juices as an Indication of the Fertilizer Requirements of the Soil.

By HERBERT WALKER and GEORGE B. GLICK,
Pioneer Mill Co., Lahaina, Hawaii.

In a former article[1] the determination of plant-food ingredients in cane-juices was suggested as an aid in determining the fertilizer requirements of soils; and the results of a number of analyses were given showing a relationship between the phosphoric acid content of cane juices and that of the soils from which they were derived. We have lately extended this general idea to include the determination of potash as well. The customary method of weighing potash as the chlorplatinate requires more time and attention than can usually be afforded in a sugar factory laboratory. Sherill's centrifugal method,[2] modified for cane juices as follows, was found to be much more rapid and fairly accurate. The determination is based upon the relative volumes of precipitates formed from two solutions, the potash concentration of one of which is known.

Reagents and Apparatus Used.

Standard 1 per cent. K_2O *solution.*—Weigh carefully 15·83 grms. of C.P. potassium chloride, dissolve in distilled water in a litre volumetric flask, add 8 or 10 drops of glacial acetic acid, and dilute to 1000 c.c. with distilled water.

Sodium cobaltic nitrite stock solution.—To 225 grms. C.P. sodium nitrite ($NaNO_2$) add 400 c.c. distilled water, and allow to stand overnight with occasional stirring. At the same time dissolve 125 grms. C.P. cobalt acetate in 400 c.c. distilled water. When the sodium nitrite is all dissolved pour the cobalt acetate solution into it and mix thoroughly by pouring repeatedly from one beaker to the other. Then dilute to 1000 c.c. with distilled water. This solution keeps very well for several months. A precipitate may form on long standing, but has no harmful effect, as it entirely dissolves when the stock solution is diluted and acidified for use.

Sodium cobaltic nitrite solution for use.—To 100 c.c. of stock solution add 65 c.c. distilled water and 5 c.c. of glacial acetic acid. Mix by shaking and allow to stand overnight in a loosely stoppered bottle. Sodium cobaltic nitrite does not keep very well after it is acidified, so that it is advisable to make up only enough for one day's supply at a time.

Centrifuge.—A Babcock milk-testing hand centrifuge with a 4-tube head and fitted with cork liners to take potash centrifuge tubes[3] is employed.

Potash centrifuge tubes.—These[4] should be calibrated before using. Using a 1 c.c. pipette graduated to 1/100 c.c., transfer 0·3 c.c. of mercury to one tube.

[1] *I.S.J.*, 1923, 214. [2] *Sugar*, 1921, 23, Nos. 5 and 6.
[3] Braun-Knecht-Heimann Cat. No. 4344 will answer the purpose well.
[4] Also obtainable from Braun-Knecht-Heimann.

By using the capillary tube for washing (described later), the mercury can be made to go down into the stem. The 0·3 c.c. should fill the tube to the 15 mark. Transfer this mercury through a funnel from one tube to another. Record calibrations and compute factors where necessary.

Capillary tube.—This is drawn from 1/8 in. glass tubing to about 4 in. in length. It should be connected to a large wash bottle, and is used to wash the precipitates out of the tubes.

Procedure followed.

Determine the degree Brix of the juice and from this the sp. gr. To about 500 c.c. add milk-of-lime to faint phenolphthalein alkalinity; heat juice to boiling, and filter through a dry Buchner funnel, using suction. Pipette 150 c.c. of the clarified juice, which must be bright and free from suspended and colloidal matter, into a 400 c.c. beaker. Evaporate to less than 50 c.c. on a water bath or hot plate; transfer to a 50 c.c. volumetric flask; add 2·8 c.c. of glacial acetic acid; and make up to 50 c.c. after cooling to room temperature, which should be above 72°F.

Transfer 17 c.c. of the sodium cobaltic nitrite solution to each of two potash centrifuge tubes. Be sure that the stems are full of water and contain no air bubbles before adding the nitrite solution. To one tube add 5 c.c. of the standard 1 per cent. K_2O solution and to other 5 c.c. of the prepared sample. Centrifuge at once for one minute at 1000 r.p.m. Allow the machine to come to a stop, remove each tube, level the precipitate by tapping the stems gently with the finger, replace in the machine, and centrifuge for 15 secs. more. Read and record results.

$$K_2O \text{ per cent.} = \frac{50 \times \text{reading of sample}}{150 \times \text{sp. gr. of juice} \times \text{reading of standard.}}$$

Juices which are very low in K_2O, and do not give a reading sufficiently close to that of the standard to be reliable, should be run again, using 10 c.c. of the sample in one tube and 5 c.c. of the standard K_2O solution with 5 c.c. of distilled water in the other. In this case, the formula gives twice the percentage K_2O in the juice.

The standard K_2O solution does not give constant readings, due to temperature differences and to the age of the sodium cobaltic nitrite solution. Hence it is necessary to run a tube of the standard with every sample, or set of samples.

It is essential that the concentrated sample be bright and contain no precipitated or suspended matter after the acetic acid is added. If this is not the case, further clarification must be effected by acidifying the filtrate from the lime clarification, heating and again filtering before taking the 150 c.c. for analysis.

For comparative purposes the specific gravity of the juice may be neglected and results expressed as grms. of K_2O per 100 c.c. juice.

Results obtained with Crusher Juices.

We have started a complete phosphoric acid and potash survey of all our fields, based on analyses of crusher juice samples. Present indications are that none of our fields are in need of potash, and that we shall probably be unable to derive a "safe minimum" figure from the juices of canes grown on this plantation. We have, however, found distinct and constant differences in the amount of K_2O in juices from different fields.

The effect of potash fertilization in increasing the K_2O content of cane juices is shown by the following tests of juices from Plant Food Experiment No. 4, Crop of 1923, a field experiment laid out to determine the increase in yield of sugar

due to potash and phosphoric acid. The plots tested had received 200 lbs. nitrogen per acre, no phosphoric acid, and either 0 or 200 lbs. potash. The cane lacked several months of being ready to harvest. Three stalks were taken from each plot and run through a hand mill, the juices being analysed as follows :

Variety—Striped Mexican.

O PLOTS—No K_2O.

PLOT NO.	PER CENT. K_2O.		PER CENT. P_2O_5.
128 C..	0·115	....	0·012
138 C	0·088	....	0·010
148 C..	0·073	....	0·008
136 C	0·078	....	0·017
132 C..	0·082	....	0·017
142 C	0·065	....	0·015
152 C..	0·056	....	0·010
Average.. ..	0·0796	....	0·0127

J PLOTS—200 lbs. K_2O.

PLOT NO.	PER CENT. K_2O.		PER CENT. P_2O_5.
141 J..	0·088	....	0·010
131 J	0·167	....	0·012
151 J..	0·181	....	0·017
161 J	0·158	....	0·012
145 J..	0·173	....	0·015
137 J	0·083	....	0·008
147 J..	0·114	....	0·010
157 J	0·187	....	0·015
Average.. ..	0·144	....	0·0124

Although there is a considerable variation among the individual analyses which would be expected from the small samples used, the average juices from the K_2O plots are somewhat higher in this element. Since this field showed no decided gain from either potash or phosphoric acid when previously harvested in 1921, it seems probable that the canes from all plots have taken up a sufficient amount of these ingredients from the soil.

A similar test was made on canes from an experimental field in Olaa plantation. These soils have always given an increased yield from potash fertilization.

Variety—Yellow Caledonia.

ANALYSIS OF JUICES FROM SMALL HAND MILL.

No K_2O ADDED.

SAMPLE NO.	PER CENT. K_2O.		PER CENT. P_2O_5.
1	0·028	....	
5	0·027	....	
9	0·057	....	0·030
13	0·048	....	
17	0·050	....	0.034
21	0·049	....	0·035
25	0 021	....	0·032
Average.. ..	0·040	....	0·033

200 lbs. K_2O PER ACRE ADDED.

Sample No.	Per Cent. K_2O.		Per Cent. P_2O_5.
4	0·074	....	
8	0·076	....	
12	0·104	...	0·035
16	0·137	....	0·032
20	0·119	....	
24	0·099	....	0·032
Average..	0 101	....	0·033

This series shows still more strongly the effect of fertilization on the amount of potash in juices, where the soil contains only a very small amount. The figures for P_2O_5 are given as an additional check on the effect which local variations in soil or cane might cause. Neither series showed any apparent influence of potash fertilization on the P_2O_5 content of the juice.

Summarizing the two experiments, a cane juice containing less than 0·05 per cent. K_2O indicated the need of potash fertilization, and one containing 0·10 per cent. did not. Whether these or any figures may be generally applicable, or whether they may have to be modified for different cane varieties and localities, will require a much more extended investigation to establish. They may at least serve as a guide for future work along this line.

Report on Progress made in Sugar Machinery Design in Louisiana.[1]

Cane Carriers.

The majority of cane carriers in Louisiana are of the steel link-chain type, which has the advantage of low first cost; but in many cases it would probably be found that the loss of time in dollars and cents would soon pay for the more desirable and more modern type of roller chain carrier which is used on some estates. Revolving cane knives, operating at the base of the main carrier, and the use of a sub-carrier, such as is used in Cuba, may prove very beneficial to Louisiana conditions in getting a better feed to the mill, higher extraction, and increased capacity. There are factories in Cuba, using this method in conjunction with the side-dumping cars, that grind 3000 tons of cane per day employing three men per watch.

Crushers.

The subject of double crushing has been constantly brought up, but the Committee feels that since Louisiana cane never reaches maturity, and is not of high fibre content, it is not as important as it is in the tropics. Most Louisiana mills would be more benefited by an additional 3-roller mill than they would be by the installation of an extra crusher. There are automatic cane feeders to give uniform feed to crushers used in the tropics where short cane of 3 to 4 ft. length is ground. but we do not consider that such apparatus could be recommended for Louisiana factories on account of the length of the cane. Some factories encounter trouble with the crusher in that it does not take the proper feed. Increasing the angle of the chute in many cases will rectify this and prevent slipping, thus increasing the capacity of the mill. In some Cuban factories the angle of this chute is 55°, whereas in Louisiana there are some as low as 30°.

[1] Summary of the Report of the Committee on Mechanical Progress of the American Sugar Cane League, consisting of Messrs. B. F. Hochenedel (Chairman), Wm Whipple and Antonio Guell.

MILLS.

Some factories in Louisiana have found from experience that, with Messchaert grooving of the proper spacing and depth on the feed rolls, using new type cleaning fingers, they have increased the extraction greatly. It is true that the life of rolls with Messchaert grooving is short, but if proportionately higher extraction is obtained by their use it may justify re-shelling every three years. It has been the practice in Louisiana to use a groove of eight to the inch on all the rolls, but in recent years the tendency has been to increase the size. There are a number of mills using four to the inch, and having a pitch as large as ⅝ in. with satisfactory results in respect of increased extraction. The use of springs on top roller scrapers prevents slipping and excessive wear with the rise and fall of the roll under varying feeds. This Committee feels well justified in saying that had a number of rollers used last season been re-shelled previous to grinding, they would have more than paid for themselves in a single crop in increased extraction.

INTERMEDIATE CARRIERS.

The Meinecke intermediate carrier was introduced into Louisiana at the Youngsville factory last season and gave very satisfactory results. For those who contemplate new installations or renewals in this direction, it will be worth while to investigate the Meinecke. Cinclare is to instal two Ewart intermediate carriers on their mill this summer. These have given excellent results in Hawaii and have the advantage of cleanliness and open walking space (also obtained by the Meinecke) and also have a pushing effect on the bagasse feeding the following mill. But they, on the other hand, have the disadvantage of a number of moving parts which might be subject to breakage and cause delays.

JUICE STRAINERS.

If a juice strainer could be perfected on the principle of the grasshopper sugar conveyor, it would have great advantage over the present style of apparatus. It is easy to see what an advantage in the life of the screen and the loss of time and trouble experienced with the old type would result if the use of moving flights could be done away with. The mesh found most adaptable in Louisiana is 144 holes to the sq. in. Where any appreciable amount of maceration water is used on a mill with nine or more rollers, it is strongly recommended that the last mill juice be pumped on to the bagasse coming from the front mill. It has been found in many cases that this procedure has increased the extraction one-half per cent. with the same amount of maceration water. The cane trash from the juice strainer should be distributed in such a manner that it will receive the maximum amount of crushing and have the advantage of both maceration waters.

LIMING APPARATUS.

The various liming stations or systems now in use in the State could be much improved upon, it being evident that this station has not kept pace with the marked forward movement of the other departments of the factory. At one of the larger houses in Louisiana, liming at the mill with a constant stream of 11° Bé. milk-of-lime is applied to the juice as it flows into the juice strainer. This process greatly improves the clarification. However, it was necessary to add part of the lime only at the mill and the additional amount necessary for the clarification in liming tanks, as it was found that *Leuconostoc* formed in the tanks and pipes when the juice became nearly alkaline. Experiments have shown conclusively that a large portion of the colour in final molasses is caused by the destruction of glucose in juices locally over-limed, and not properly mixed before heating.

JUICE HEATERS.

It is strongly recommended in the purchase of new heaters, or the remodeling of old ones, that the high velocity type be chosen since the speed of the juice keeps the tubes clean. By removing the incondensible gases from heaters through small petcocks, properly placed, the capacity of the heaters can be greatly increased. It is found that the use of a thermostat to control the temperature of the juice is a valuable asset, but the thermostat bulb should be kept clean if a constant temperature is desired.

SETTLING TANKS.

This coming year the new Ruckstuhl and the Dorr clarifiers are to be installed in a few sugar houses. These apparatus should greatly improve the settling method, and lower the labour costs. One of their advantages is the fact that floating bagacillo and wax are removed, which should give the beautiful clarification obtained with the old type open clarifier and make a much cleaner sugar. Cinclare is installing this year the complete Petree process, which returns all the muds from the settlers to the mills.

FILTER-PRESSES.

Practically all the factories in the State adhere to the plate-and-frame press. The Committee strongly recommends the use of a low pressure line and a high pressure line, with two separate pumps, as this prevents the slowing down of all partially filled presses when starting a new one.

EVAPORATORS.

All factories having double effects should make an effort to convert into triple effects by the installation of a third body. In making such changes it is very important to have the vapour pipe properly proportioned to accommodate the varying volume of gases in the different bodies, and the withdrawal of incondensible gases at top and bottom of the calandria. In the operation of a double, triple or quadruple effect a uniform juice level should be maintained at all times; and there are automatic level controls in use in some of the large factories that have proved very beneficial. It is essential that the right distribution of steam in the calandria be maintained, and that the condensed water and incondensible gases be properly removed, and several factories have found it advisable to remove a number of tubes to form steam lanes for the steam to reach nests of tubes formerly inactive. By so doing the capacity of effects can be greatly increased as a whole. The coating of cylinder oil, which always exists (to more or less extent) on the inside of the calandria of the first body, can be removed by using soda ash. An oil separator of sufficient size will remove most of the oil in the exhaust steam, thus keeping the heating surface clean.

A process in quite general use in white sugar manufacture is the heating of syrups to the boiling point temperature and then allowing them to settle before drawing them into the pan. It is claimed that this is very beneficial to the syrup in making it brighter and assisting the settling of insoluble solids.

VACUUM PANS.

This is a station which has been at a standstill during the many forward steps of the rest of the sugar-house. Calandria pans in Cuba proved to be more rapid boilers than coil pans then in use. If coils are longer than 200 times their diameter, the heating surface beyond this point is of little value. In the larger pans steam should be admitted to the coils from two opposite sides with the headers 180° apart, so as to distribute heat more evenly and improve circulation. If it were possible to completely remove the air from the coils, the heating surface would be much more efficient.

CENTRIFUGALS.

Manufacturers of centrifugals have made wonderful strides in improving the different types of machines; but none of the newer types have been installed in Louisiana to our knowledge. Many factories have applied attachments to their old machines which have resulted in the saving of labour, sugar, and fuel. These include sugar dischargers, lap joints on basket lining, automatic and Weber type sprayers, and the separation of wash from run-off. There are several makes of belt-driven rotary pumps which are very satisfactory for handling molasses. Several factories are now using internal combustion engines for drying their second and third sugars, with marked decrease in fuel consumption. Provision has to be made for driving all pumps from the line shaft. Of course, if it is necessary to furnish steam to boil the molasses, this method would not be so economical.

GRANULATORS.

Thermostat control is being successfully used in several factories, and it is to be recommended, as it will enable the operator to maintain the temperature at any desired point.

It is impossible to operate a granulator without the creation of dust. This dust is handled by the dry method in the usual dust collectors, or by the wet method using spraying nozzles, as used in the Vachier dust collector at Union, and the Buffalo Squier reclaiming chamber.

BOILER ROOM.

Bagasse furnaces have been made more efficient because furnace volumes in general have been increased. Flat furnace arches are becoming more popular; grates have been made smaller, decreasing the lengths to not more than 5 or 6 ft. to eliminate holes in the rear, which in the past have played havoc with the stack draught; shaking grates are now almost universally used; modern bagasse hoppers; mechanical and hand soot blowers; asbestos and diatomaceous insulating materials; boiler wall coating or steel casing; and modern draught-gauge furnace control, aided by simple hand combustion indicators.

It is well known that any standard type of boiler will give good results if it is properly set and the operating man makes an effort to become thoroughly familiar with it, but a good supply of feed water is necessary to keep the heating surfaces free of scale, to be able to obtain good over-all efficiency. Factories which have bad feed water should by all means investigate the use of the so-called "sweet water" which, if free of sugar, pumped while hot, and sprayed so as to remove the objectionable gases it contains, will give a fine supply of almost pure water.

Briefly stated, oil furnaces have improved because furnace volumes have been increased; burners have been placed further away from the heating surface to secure more efficient combustion and the air supply has been distributed more evenly to avoid the blow-torch effect which is so wasteful of oil; and modern furnace control, including dampers, draught-gauges, and hand combustion indicators, is now a little more in use.

Dr. F. W. ZERBAN has been appointed Chemist in Charge of the New York Sugar Trade Laboratory in succession of Dr. C. A. BROWNE, who, as already announced, has been made Chief of the Bureau of Chemistry, Washington. Dr. ZERBAN until now has been Director of Research and Supervising Chemist to Penick & Ford, Ltd., of New Orleans, and formerly he held the posts of Research Chemist of the Louisiana Sugar Experiment Station, and Director of the Sugar Experiment Station, Lima, Peru. The several valuable bulletins and articles which he has published during the past few years have shown him to be a chemist of particular ability. He is Vice-Chairman of the Sugar Division of the American Chemical Society.

The Care and Revivification of "Norit" Decolorizing Carbon.

By J. N. A. SAUER,

General Norit Company, Ltd., Amsterdam.

I.—Treatment of "Fresh Norit."

Fresh "Norit" as received from the factory contains a small amount of soluble alkaline matter. This is easily removed, by giving it the regular acid treatment (using 1 per cent. hydrochloric acid), washing it to neutrality, and then passing it through the reburning furnace. Neutral "Norit" can, however, be bought, if desired.

II.—Care of "Norit."

Spent "Norit" should not be allowed to become unnecessarily soiled by allowing refuse, sweepings, and all kinds of dirt to get mixed with it. It should contain no sugar when stored dry, but should previously be properly washed.

If "Norit" to be stored contains sugar which for some reason cannot be washed out at the time, it is best to store the carbon suspended in water, so that the sugar and other impurities may be removed by the fermentation process which will set in. The impurities will rise to the surface and can be skimmed off, and the "Norit" can be pumped to filter presses, washed with hot water, and made ready for further cleaning, chemical treatment and reburning.

If "Norit" which has undergone such a fermentation process is difficult to filter, add about 1–2 per cent. ordinary salt (Na Cl) to the mixture and boil.

III.—Impurities in "Norit."

"Norit" which has been applied only to properly washed cane sugar melt of say 99° purity, which melt has moreover been pre-filtered with kieselguhr, will contain in adsorbed and occluded form the following:—

A. Inorganic Matter.
   1. All kieselguhr which may have gone through the cloth of the filter bags.
   2. Other inorganic matter, such as lime, silica, etc., present in solution in the pre-filtered sugar liquor.

B. Organic Matter.
   1. Colouring Matter.
   2. Other organic non-sugar matter such as gums, pectins and other slimy matter, organic acids, etc.
   3. Sugar.

If the raw sugar has not been well washed (affinated), the proportion of the above substances adsorbed by "Norit," will of course be greater. If the sugar liquor has not been pre-filtered through kieselguhr before the "Norit" is applied, a certain amount of bagacillo and other fibrous matter (from the sugar bags, for instance) and also lime salts, phosphates, silica, etc., present in suspension or in colloidal state in the sugar melt will also become entangled between the "Norit" particles.

Inorganic impurities.—With the exception of lime and phosphates, there are some substances which are not sufficiently removed by the treatment of hydrochloric acid alone or combined with reburning.

An accumulation of such substances will show up first by the decreased filtration capacity of the "Norit" and its ash content. If the ash is still high after treatment with hydrochloric acid, and if this acid treated "Norit" shows a decreased filtering capacity, it would be advisable after the hydrochloric acid

treatment to give a treatment with carbonate of soda, caustic soda, or a mixture of the two. If there is an accumulation of gypsum, carbonate of soda followed by washing with water, acid, and water again should be used. Alumina and a large proportion of silica if present (which is almost always the case) can be removed by boiling with caustic soda, followed by a washing with water.

A large amount of kieselguhr is rather detrimental. It adds to the bulk. Chemicals will not remove it, but only break it down to an impalpable powder which hinders filtration. Reburning at the temperature used for revivifying "Norit" (about 600°C., 1112°F.) will deteriorate it to such an extent that it loses practically all of its filtering capacity. If kieselguhr is heated above 300°C. (572°F.), it sinters and breaks down, loosing its structure.

It is not necessary to use kieselguhr in combination with "Norit." In fact "Norit" may easily be used instead of kieselguhr for pre-filtration.

Organic impurities.—The amount of these taken up by "Norit" from a well-washed sugar solution is relatively small and only after prolonged and repeated use with such liquors does a substantial accumulation of the carbonized ash of such substances occur. Organic matter when burned is transformed into extremely fine, non-porous and non-active carbon, except when it is given a special treatment in order to activate it. It can, however, in no manner be made coarser. Therefore such carbon usually, if not activated, only adds to the bulk and hampers decolorization and filtration.

A large accumulation of such matter should therefore be avoided as much as possible by: (1) Washing the raw sugar (say up to, or over 99° purity); (2) Washing the cakes free from sugar; (3) Using a pre-filtration with "Norit," which is used separately for filtration purposes only, this "Norit" being then regenerated mainly by the use of hydrochloric acid, while reburning is applied only occasionally when necessary; (4) Using a pre-filtration with kieselguhr; (5) Giving the "Norit" (at least now and then) a chemical treatment (for instance, a soda treatment) prior to its reburning; (6) Subjecting the "Norit," prior to its reburning, to a fermentation process. This is, however, a cumbersome procedure.

IV.—FINE AND SECONDARY CARBON PARTICLES AND THEIR REMOVAL.

If too many fine particles are present in the carbon they show up in two ways. First: The filtration and decolorization capacities are greatly diminished. When the fine secondary carbon is activated, only the filtration capacity is inferior, while the decolorization capacity might even be superior. Second: Some fine particles of carbon may pass through the cloth.

The remedy is: (1) To sieve out the extremely fine secondary carbon or the broken down particles; or (2) To mix with new "Norit," in a certain proportion depending upon the quantity of "fines" present.

A very fine sieve is necessary for sifting out the fine secondary carbon, viz., one of 200 mesh to the linear inch. All that passes through this sieve is discarded with the exception of about 10 per cent. on the weight of the "Norit." The refuse may be mixed with kieselguhr, if used for pre-filtration. A "Hummer" as used by refiners for sifting sugar is a good sieve, but a gauze of 200 mesh has to be used.

The amount of fine secondary carbon should not be more than about 10 per cent. of the total "Norit." About 10 per cent. of fine (200 mesh) "Norit" is necessary for the adsorption of the finer colloidal matter and should be left in the "Norit."

It must be clearly understood that it is highly advisable to avoid the accumulation of secondary carbon in "Norit" and to remove as much as possible of the organic matter present prior to the reburning.

The removal of secondary carbon can be effected by:

(*a*) A treatment of caustic soda after reburning. The carbonized organic matter (which is not active) can be dissolved out of the "Norit" by treating the reburned "Norit" with a relatively strong caustic soda solution, preferably under pressure. When the secondary carbon has been activated, that is transformed from a carbon compound to the elementary porous carbon, it is practically impossible to dissolve this carbon without harming the structure of the "Norit."

(*b*) Burning away the secondary carbon during the reburning process by admitting some oxygen, preferably in "diluted" form, to the incandescent "Norit," for example by introducing air, steam, carbon dioxide or carbon monoxide at the discharge end of the lower retort. Care has to be exercised that no appreciable amount of "Norit" is burned away at the same time. The finer secondary carbon (a carbon compound) is more easily consumed by oxidation than the coarser "Norit" (substantially pure carbon). Superheated steam or flue gases (containing mainly CO_2, CO, oxygen and nitrogen) resulting from the burning of coke in the furnace can be utilized. The amount of gas necessary is very small, a supply obtained through an opening $\frac{1}{16}$ in. is ample.

When the said gases are introduced in small amounts they are able to activate the secondary carbon; but it is only when a larger amount of gas is used than is necessary for activation that the secondary carbon is consumed. Too much active gas will also consume "Norit." Therefore the amount of active gas should be regulated and this can be determined only by trial.

When the secondary carbon has thus been activated, the reburned "Norit" may show greater absorbing capacity for colouring matter and slimy matter than even fresh unused "Norit." But the greater the accumulation of such fine carbon, however active it may be, the less becomes the filtering capacity of the "Norit." It is better, therefore, to remove such secondary carbon than to activate it and leave it in the "Norit."

In order to dissolve secondary carbon, the "Norit" should first be boiled in a wooden acid vat for about one hour with a 1-2 per cent. solution of hydrochloric acid, the mixture diluted down and the "Norit" cakes washed with hot water. It is then reburnt, and the secondary carbon is removed by boiling for one hour under pressure in a closed iron tank at a temperature of about 130°C. (266°F.) with a 10 per cent. caustic soda solution. The secondary carbon, or rather carbon compound, if present in small quantities, is dissolved rather easily. If this soda treatment is given after each reburning, the "Norit" can be kept practically free from secondary carbon, in which case boiling under atmospheric pressure is sufficient.

V.—Acid Treatment of "Norit."

To about 2000 lbs. of wet "Norit" 400 gallons of water is added and about 150-300 lbs. of commercial 30 per cent. hydrochloric acid. This makes a strength of about 1-2 per cent. of acid on all of the water present in the tank (taking it that the wet "Norit" contains about 50 per cent. moisture). This moisture is boiled for about one or two hours with open steam and the contents of the tank is thereafter diluted further by adding water up to the 4000 gallons level, pumped through ordinary acid presses and the cakes washed out with water to neutrality. It is advisable to use wooden presses and acid-resisting pumps and pipes. Some carbonate of soda solution (strength at ½ to 1 per cent.) should be passed through the press to neutralize the acid left.

"Norit" thus treated can be used again directly after neutralization with soda, or, better, it should undergo a reburning treatment before being again used.

Removal of iron.—To remove all iron, the acid strength should not be diminished too much through dilution with water, otherwise the "Norit" might be able to re-absorb that in solution. In fact this is also true for the other impurities removed to a greater or lesser extent, usually less. In the modified case two acid tanks are used instead of only one. After having boiled the mixture, no dilution with water takes place, but the "Norit" is allowed to settle in the first wooden acid vat, and the supernatant acid, which contains practically all the impurities in solution is drawn off into the second acid vat. Water is added to about the 4000 gallons level to the "Norit" left in the first vat. The diluted "Norit" paste contains scarcely any acid, so that iron presses, pipes, pumps, etc., cannot be attacked by the acid left in the acid "Norit" mixture. On diluting the mixture thus, practically no re-adsorption can take place.

The acid in the second vat is diluted by filling up with water, allowed to decant, and the supernatant liquor run to waste. These acid vats are used alternately.

VI.—Soda Treatment of "Norit."

The soda treatment can be carried out in the soda treatment tank or in one of the iron mixing tanks for liquor and "Norit." Treatment of "Norit" with a soda solution stronger than 5 per cent. should not be carried out in wooden vats, but in iron tanks or in other alkali-resisting receptacles.

The "Norit" to be treated with soda must have been previously acid treated and washed with water to neutrality, otherwise filtration difficulties may be encountered. Phosphates, etc., are precipitated on the "Norit" in the form of a fine slimy and impervious mass which makes filtration very difficult and even impossible, but the hydrochloric acid treatment removes most of these impurities.

To 300 gallons of water in a tank (of 2500 gallons capacity) add 2000 lbs. of wet spent "Norit," then about 100 gallons of a 10–25 per cent. soda solution (100–250 lbs. of soda to a gallon of water) is added. There is then present about 1000 lbs. of dry "Norit" in 500 gallons or 5000 lbs. of water (this includes 1000 lbs. of water in the wet "Norit" and the 100 gallons of water in the soda solution), which makes a strength of about 2–5 per cent. of soda on all the water. Either 100-250 lbs. of caustic soda or carbonate of soda, or a mixture of 50-125 lbs. of each is to be used.

This mixture of "Norit," water and soda is stirred continuously and boiled for one or two hours with open steam (or with an iron steam coil), at the end of which time the contents of the tank is diluted by adding water up to about the 1500 gallons level. This dilution with water brings the strength of the soda solution to about 0·2 per cent. The soda strength should not be reduced too much by diluting with water; otherwise the "Norit" might re-adsorb the impurities just dissolved out of it. The diluted mixture is then pumped through ordinary presses, and the cakes formed are washed out with water to neutrality. The 0·2 per cent. soda solution will not attack the cloths if they are made of pure cotton. "Norit" so treated can be used again directly, or, better, should first be subjected to a reburning treatment. A treatment either with caustic soda, carbonate of soda or a mixture of the two after the reburning is most beneficial for the removal of silica, alumina, etc., or to remove secondary carbon.

VII.—Reburning "Norit."

In order to obtain reburned "Norit" uniform in its decolorizing capacity it is very important that the temperature in the retorts is not allowed to fluctuate. A variation of only 28°C. (50°F.) will not affect the decolorizing capacity.

"Norit" that has been used on a well-washed melt will require about two hours time to pass through the retorts of a two-ton double "Norit" kiln. If

used on a lower grade liquor, a longer time will be required, or else the temperature will have to be increased.

As stated above, if the secondary carbon is to be removed from the reburned "Norit" by the use of soda, this secondary carbon should not first be activated. So the temperature applied for reburning should not be too high—not over 500°C. (932°F.).

It is very important that all sugar be washed out of the "Norit," even if it does not pay commercially to remove the amount. In washing out up to say 0·1° Brix the sweet water is brought back in process, then the washing in the press is thereafter prolonged for about another half hour or so and the hot water so used is run to waste if it cannot be used for melting sugar, the idea being mainly to remove traces of sugar in order to save the "Norit" itself.

Sugar present in "Norit" which is reburned is transformed into non-porous and non-active extremely fine secondary carbon. Five per cent. of sugar if left in the "Norit" to be reburned is in the long run detrimental to the filtration and decolorization capacity of the "Norit," because it is transformed to secondary carbon.

A higher temperature will be required for the efficient reburning of spent "Norit" used on low grade sugar products than for high grade sugar products. If the customary temperature of 600°C. (1112°F.) is employed, the capacity of the furnace must be decreased in order to obtain a well burned "Norit." If temperatures of over 600°C. are to be applied the retorts of the "Norit" oven should be made of more refractory material than cast-iron, and manganite or chrome-nickel alloys should be used for the retorts or chamotte (fireclay) or silica retorts be applied.

VIII.—Order of Treatments.

"Norit" may be treated by any one of the foregoing treatments, or by any suitable combination of them. The proper treatment depends entirely on the type of liquor on which "Norit" has been used. For example, if "Norit" is used only on high grade liquors, such as washed sugar melt of 98·5–99° purity, and for filtration purposes only, a treatment with hydrochloric acid only will suffice (followed, of course, by a wash with hot water, neutralizing the remaining acid with a dilute soda solution, as described).

If the "Norit" is also to decolorize to a large extent this washed sugar solution, the following treatments should be applied: (1) acid; (2) reburning; (3) wash with water. The soda treatment in addition needs only to be given occasionally after the "Norit" has been regenerated many times in the above manner and no longer gives good results, or if it is desired for removing the secondary carbon from the "Norit."

If the "Norit" is used on low grade liquors, molasses, cane or sorghum juices, the treatment should be: (1) acid; (2) soda; (3) reburning; (4) acid and/or soda; (5) wash with water. Or: (1) acid; (2) reburning; (3) soda, and (4) wash with water. For the removal of secondary carbon present in the "Norit" the use of superheated steam or flue gases is recommended instead of the soda treatment. By knowing what has been adsorbed, the chemist will be able to decide the regenerative treatment suitable. The proper treatment fully restores "Norit" to its original efficiency.

IX.—Remarks.

As "Norit" can easily be freed from sugar with the use of hot water, no sugar loss need occur, and no sugar need be left in the carbon. Both acid and soda treatments will remove sugar, because soda and acid are adsorbed and the

adsorbed sugar is thereby freed. The amount of organic non-sugar matter adsorbed by "Norit" from a melt made from well washed sugar will never reach 5 to 10 per cent. on the weight of the carbon, and therefore can never cause such a quick deterioration as might result from sugar left in the "Norit" to be reburned.

"Norit," if treated and regenerated properly, does not break down easily and can be used and revivified by burning at least one hundred times. When properly handled "Norit" is a good filtering medium and remains so even after repeated use and repeated revivification by chemicals (acid and soda) and by reburning.

The bagacillo and other fibrous matter adsorbed or filtered off in between the "Norit" particles are also burned to non-porous, non-active carbon, but as a rule the secondary carbon so produced is not formed into such an extremely fine carbon and therefore does not do so much harm as carbon produced from sugar. Carbon from fibrous matter generally shows a structure when carbonized.

When about 2 per cent. of "Norit" on the weight of sugar is used, which "Norit" is then reburned, the calculation of the number of times it has been used is as follows:—

Say you have bought a total of 10 short tons of "Norit," which is 20,000 lbs.; each 2 lbs. of "Norit" treats 100 lbs. of sugar, and is then reburned; 20,000 lbs. will thus treat each time 1,000,000 lbs. of sugar.

$$\frac{20{,}000 \text{ lbs.}}{2} \times 100 = 1{,}000{,}000 \text{ lbs. or } 500 \text{ short tons.}$$

Suppose your total treatment in and out of season was 50,000 tons (100,000,000 lbs.) of sugar. Then in the years since you purchased your "Norit," it would mean that the 10 tons have been regenerated 100 times by reburning.

The price of "Norit" is at present $300 per short ton of 2000 lbs. f.o.b. New York including bags, say $350 delivered factory, or 17·5 cents per lb.

If 2 lbs. of "Norit" per 100 lbs. of sugar is applied, and if this is used 100 times, it means that 2 lbs. is good for the treatment of 10,000 lbs. of sugar, or 1 lb. of "Norit" for 5000 lbs. of sugar. In other words the cost of material for the treatment of 100 lbs. of sugar is:—

$$\frac{17{\cdot}5}{5000} \times 100 = \text{only } 0{\cdot}35 \text{ cent.}$$

If "Norit" is used 50 times only, the cost is 0·7 cent per 100 lbs. of sugar and if used 25 times the cost is 1·7c. per 100 lbs. of sugar. Even this last figure is certainly not excessive.

A detailed analysis should be made of the ash content of the "Norit." Also the "fines" in the sample should be determined by sieving, using a 200-mesh sieve. Guided by this analysis and by the above information the manufacturer will know how to proceed in order to get the "Norit" back to its original efficiency.

It would be advisable in the future to give at least once a week to all the "Norit" a chemical treatment, first with acid and then with soda (mixed caustic and carbonate of soda) previous to its reburning. This treatment is especially recommended when it is not possible to treat the "Norit" each time before reburning with acid and after reburning with soda. It might appear superfluous to do it each time, but it is a wise precaution and will pay in the long run.

For the revivification of spent "Norit" treatment with lime to activate the secondary carbon in the "Norit" is not correct. We have discovered that it only restores the decolorization capacity but that it breaks down the "Norit" particles very much at the same time, so that after a few such regenerations practically all of the "Norit" is transformed into an impalpable powder which is useless as a filtering medium, although it may decolorize well.

Publications Received.

Alcoholic Fermentation. By Arthur Harden, Ph.D., D.Sc., F.R.S., Professor of Biochemistry, University of London. Third Edition. (Longmans, Green & Co., London, New York, and Bombay.) 1923. Price: 6s. 6d. net.

Dr. Harden's monograph, the two previous editions of which were noticed in our columns at the time of their publication,[1] is one of very great interest to all concerned in the fermentation industries. It reviews in a very lucid way the great amount of work that has been done in explaining the nature of a phenomenon that has exerted a fascination over the minds of investigators from the very earliest times. Previous to the year 1897, although the general nature of fermentation was understood, many perplexing points remained unelucidated. In that year EDUARD BUCHNER succeeded in preparing from yeast a liquid which contained an enzyme which was called *zymase* and which in the complete absence of cells was capable of effecting the resolution of sugar into carbon dioxide and alcohol. Since that date a considerable amount of information has been gained with regard to the nature and conditions of the action of the enzymes of the yeast cell; and as the result it has been found that the machinery of fermentation is much more complex than had been surmized. *Zymase*, which is essential for fermentation, cannot of itself bring about the alcoholic fermentation of sugar, but is dependent on the presence of a second substance, termed, for want of a more reasonable expression, the co-enzyme. This, however, is not all. A phosphate is also indispensable for the decomposition of sugar, and the phosphorus present in yeast juice, and also most probably in the yeast cell, goes through a remarkable cycle of changes. Thus, it is now known, largely as the result of the work of Dr. HARDEN himself, that the breakdown of sugar into alcohol and carbon dioxide is accompanied by the formation of a complex hexose-phosphate, from which the phosphate is split off and rendered available for action by means of a special enzyme, which has been called *hexosephosphatase*. Then in the cell are present other special enzymes by means of which the zymase and its co-enzyme can be destroyed, and in addition an anti-enzyme, which directly checks this destructive action. Thus an insight has been obtained into the marvellous complexity of the cell, lending, in Dr. Harden's words, "additional zest to the attempt to penetrate the darkness which shrouds the still hidden mysteries" of the problem of alcoholic fermentation.

Handbuch der Biologischen Arbeitsmethoden. Edited by Prof. Dr. Emil Abderhalden. Part 5; vols. 1, 2, and 3: Carbohydrates. By Géza Zemplén. (Urban & Schwarzenberg, of Berlin and Vienna.) 1922. Price: 45s.

Abderhalden's previously published volumes on biological chemical methods are well-known, and the section dealing with the Carbohydrates has now appeared. It is in three volumes, and has been compiled by Prof. GÉZA ZEMPLÉN, of Budapest, in collaboration with Dr. ROLAND OSVALD, of the same city. It deals with the constitution of the carbohydrates, their identification, their determination, their preparation and their synthesis; the glucosides, their preparation, and properties, which information is set forth in such great detail that this work will form the most complete collection of information relating to the compounds under consideration. References are given to the original sources from which the matter recorded is derived, and it is certain that this section of the "Handbuch" will be invaluable to students working in this branch of organic chemistry.

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[1] *I.S.J.*, 1911, 394; 1914, 332.

Trade Notices.

Double and Single Low and High Type Crushers. (Fulton Iron Works Company, St. Louis, U.S.A.)

In most cases where improvements in cane milling machinery are contemplated, it takes considerable time for the exchange of certain information regarding floor-space and head-room. With the purpose of obviating delay from this cause, the Fulton Iron Works Company give in this publication (Bulletin 103) all the necessary measurements of three types of their crushers, viz., (*1*) low type double crusher; (*2*) low type single crusher; and (*3*) high type single crusher, so that the prospective purchaser is able to apply promptly for a quotation for an apparatus best conforming to his existing installation. Thorough preparation of the cane by Fulton crushers is the basic reason for the high extraction effected by these apparatus. Regarding capacity, it is remarked that the Fulton step-down grooving, providing large gripping areas, having open grain roll surfaces, eliminates slippage, while the rugged but sensitive hydraulic pressure regulators permit the tandem to adapt itself to the feed. Further, the human element has been practically eliminated in so far as the safe and continuous operation of Fulton machinery is concerned, all of which advantages above mentioned tend to lower manufacturing costs and increase the profits. This Bulletin, of much interest to sugar mill engineers, can be obtained on application to the Fulton Iron Works Co , St. Louis, U.S.A , and is well worth study.

Machinery for the Economical Handling of Sugar Cane. (American Hoist & Derrick Company, St. Paul, Minn., U.S.A.)

This is a particularly artistic catalogue, giving a good deal of practical information on the "American" tight bundle system of handling cane in the fields, from cart to mill, which system consists of self-tightening chain slings, spreaders, transfer derricks (horse-power and steam), horse-power and steam engines, and steel storage cranes. In regard to the chain slings, this is the original automatic trip, which has been improved to meet the most severe cane handling requirements, and materially reduces investments in mules, carts and cars. In the act of hoisting, the trip runs down on the chain, automatically tightening the bundle, so that no cane can possibly slip out. There is no way for this bundle to loosen until the trigger is released, so that the bundle can be handled as many times as required without the spilling of a single stalk and without the least damage being caused to the cane. A full specification with illustrations is given of the "American" horse-power derrick, the simplicity of which apparatus has made it a favourite among growers, thousands being in use at the transfer points of cane fields. Besides the cost of handling the cane in the field, there is the still more important feature of consuming as little time as possible between the field and the mill, so that the cane is given the least opportunity to deteriorate. The "American" steam transfer derrick is a model plant, which loads rapidly from cart to car, cutting down the expenses of handling and eliminating loss by juice fermentation. This catalogue is both an interesting and a tasteful compilation, one which every field superintendent should have on file.

Laboratory Apparatus. (Christian Becker, Inc., 92, Reade Street, New York City, U.S.A.)

Among the specialities of this firm are a number of apparatus of much interest to the sugar factory and refinery chemist. For example, the "Chainomatic" balance, the particular feature of which is that it has no rider, and consequently no graduations on the beam, all the weighings from 0 1 to 100 mgrms. being made by adding weight to the beam by increasing or decreasing the length of a supported chain, a crank at the right hand side of the case being rotated in order to do this. As this can be done while the beam is swinging, and the case is closed, a great saving of time can be effected in weighing operations, compared with the usual system of handling small weights, manipulating riders, and opening and closing the glass door or window of the balance. "Chainomatic" balances are now in use in thousands of laboratories, in universities and colleges, and in commercial and private laboratories. This same principle is also applied in an improved form of Westphal balance, and it was recently pointed out in these columns[1] that this apparatus is in use in the laboratory attached to the Cuban Sugar Refining Co , of Cardenas. This firm also makes a special sugar balance, designed by Dr. F. Bates, of the United States Bureau of Standards, for the rapid, convenient and accurate weighing of samples of sugar for the polarimetric assay.

[1] *I.S.J.*, 1920, 525. See also *I.S.J.*, 1919, 309.

Review of Current Technical Literature.[1]

Manufacture of Standard Granulated White Sugar directly, using the Carbonatation Process. Some Remarks on the Use of Decolorizing Carbons, and on the Function of the Refiner. *Walton C. Graham.* *Facts about Sugar*, 1922, **15**, No. 27, 537-539; 1923, **16**, No. 5, 92-93.

In a previous article[2] this writer discussed the plant, labour and fuel involved in the production of plantation whites by means of decolorizing carbons, and he now turns to the carbonatation process, of which he appears to be an advocate. By this process (he says) it is possible to produce standard granulated with not more than three boilings and a final molasses as low in purity as that from the defecation process, the second and third sugars (with purities of 98-99° and 95-97° respectively) being melted back as produced and mixed with the evaporator syrup, the purity of which is thereby raised several points. Objections which may be raised to the use of carbonatation in tropical factories are anticipated. It is true that the amount of lime cake will be 10-12 per cent. of the weight of cane, and may contain about 1 per cent. of sugar, but it is said to be possible by means of improved equipment and practice to keep this down to about 0.5 per cent., corresponding to 0·04-0.05 per cent of the cane, or 0.3-0·4 per cent. of sugar in the cane. Further, the additional yield of sugar which may be obtained by reason of the higher purity of the juice (averaging 4°) will go towards paying for the cost of the extra lime, which is the principal additional cost in this process. In most places in the tropics, lime can probably be delivered to the mill (he says) at a cheaper rate than in the case of the average beet plant in the United States, and it is also probable that most of the mills in the West Indies are closer to the coke producing regions of the Eastern States than is the average beet factory of the Western and Midwestern States. Although the quantity of total massecuite to be handled in a mill making standard granulated by carbonatation is greater by 50 per cent. than that of the defecation factory, yet, owing to the greater rate at which the boiling house may be operated, equipment of the same capacity will suffice, though about 5 per cent. more water (calculated on the cane) would have to be evaporated in the pans. Also, as the result of the washing of the press cake and of the dilution of the various wash syrups, the juice would be diluted 10 per cent., which would be eliminated in quadruple effect, and would require 2·5 per cent. steam on the cane, making a total additional steam demand of 7·5 per cent. on the cane. Still, it is believed that the bagasse will supply all the necessary fuel requirements of the factory, and some will be left over for re-starting after a shut-down. Some details are given regarding the extra labour required, though the cost of this item is not computed; while in regard to lime and filter-cloth these are put down together as 25 cents per ton of cane, or probably less than 12·5 cents per 100-lb. bag of granulated sugar. Whereas in the carbonatation process the total number of operations is estimated to be 23, in the application of decolorizing carbon no fewer than 44 are stated to be necessary, and there are other disadvantages, such as more steam, more filtering and more centrifuging. Then in discussing white sugar production in the tropics, the author believes that it will eventually become established, thereby eliminating "the great waste resulting from the present practice of first making raw sugar by three crystallizations, shipping to a distant refinery, where it is re-melted, decolorized, and again crystallized a number of times at considerable expense, all this involving the investment of enormous capital, which must receive an adequate profit." There would seem to be no justification for the present practice of producing raw sugar in the tropics in this age of modern machinery, technical control, and scientific methods. "The service which is rendered by the refiner amounts to taking the colouring matter out of the sugar crystals sold him by the producer, acting as distributor of the product to the consumer, and to a certain degree financing the producer." But the refiner's function as a distributor can be

[2] *I.S.J.*, 1923, 46.

performed by the very extensive system of brokers, who are the real distributors, while financing can be aided by the jobbers and wholesalers. Further, instead of having a few refiners as customers, as at present, the white sugar manufacturer would have many buyers through the same brokerage channels as those used by the refiner.

PREPARATION OF SAMPLES OF CANE FOR THE DETERMINATION OF ITS FIBRE CONTENT. *John P. Frank.* *Reports of the Association of Hawaiian Sugar Technologists, First Annual Meeting, November, 1922.*

Each day from June 14th to July 11th two parcels of cane were sampled, and sub-sampled, two analyses being made of each parcel, one prepared with a disintegrator, and the other with a Japanese plane, the same amount of washing, pressing, and drying being given in all cases. In the case of the disintegrated sample, the average of all the results obtained was 12·97, while in that of the planed sample the figure was 12·11 per cent., and on adding 0·7 to these as the amount of fibre in the trash, the final results are 13·67 and 12·81 per cent., giving a difference of 0·86 per cent. Regarding the explanation of these results, it is pointed out that as the consequence of passing through the disintegrator the samples were transformed into two constituents, one long and stringy, and the other (derived from the pith) fine and mealy; and on mixing such a sample, a large proportion of the fine mealy particles were observed to fall through the fibrous portion to the bottom of the container. NOËL DEERR has pointed out[1] that the fibre present in the pith amounts only to about one-third that found in the rind and nodes. In the carrying out of the author's determinations, it would appear that the samples weighed for analysis which were obtained by means of the disintegrator were not representative, these containing too great a proportion of the rind and node fibre. These results, therefore, show the necessity of disintegrating the sample to a state of uniform division otherwise the chance of introducing an error is great, and the influence of the accuracy of the fibre content of the cane on other control figures is well understood by chemists.

LOSS OF SUGAR DUE TO BURNING CANE BEFORE CUTTING. *John P. Frank.* *Reports of the Association of Hawaiian Sugar Technologists, First Annual Meeting, November, 1922.*

When cane is burned before cutting, there is found on the stalks a sticky substance, the amount of which varies with the intensity of the heat to which it has been subjected, being greatest when the cane is unstripped and the trash dry. This so-called "sweating" was examined in the laboratory of the Onomea Sugar Company, and found to be concentrated juice. If the cane is sent to the mill in flumes, the sweating is of course entirely dissolved in the water, so that, in addition to the sucrose lost by deterioration between the time of cutting and milling, there is another source of loss, the extent of which is not negligible. Investigation of this matter was interrupted by a spell of rainy weather, but the results obtained so far are here reported, and are as follows:—

Condition of the Cane, and State of the Fire.		Sucrose in the Sweating, per 100 Sucrose in Cane.
Unstripped,	light fire, wet trash	0·81
,,	light burning	0·96
,,	wet trash	1·18
,,	normal fire	2·35
,,	hot fire	6·08
,,	,,	7·46
Stripped,	light fire	0·79
,,	hot fire	2·43

[1] "Cane Sugar." By NOËL DEERR. Page 186. (Norman Rodger, London.)

Review of Current Technical Literature.

IDENTIFICATION OF THE ORIGIN OF SUGAR BY THE ADDITION OF LITHIUM SALTS AND SPECTROSCOPIC EXAMINATION. *A. Herzfeld.* *Vereinszeitschrift, 1923, 205-207.* *G. Dorfmüller.* *Ibid., 1923, 207-210.*

As the result of the present state of the German sugar industry, a certain amount of sugar has to be imported to make up the scarcity, a distinction in price being made between the domestic and the foreign products. Consequently it happens that the cheaper home-grown article is hardly to be obtained on demand, most of the sugar being passed off by the retailers as the imported article so as to command a higher price. In order to protect the public, it has been proposed by BLOCK[1] and others to colour one or the other kind of sugar by means of a suitable dye as a method of distinguishing between the two ; but the Institut für Zuckerindustrie has pronounced against the feasibility of this procedure, which of course could easily be followed also by dishonest distributors. Certain authorities have, however, put forward the proposal to distinguish between the two grades by the addition of lithium salts, minute traces of which, as is well known, can be detected by means of spectroscopic examination.[2] Experiments have been undertaken to investigate this idea by the Institut für Zuckerindustrie, and a summary of the conclusions arrived at by Prof. HERZFELD, the Director of the Institut, and by Dr. DORFMÜLLER, the chemist who carried out the tests, is as follows : Examination of the ash of German beet sugars made during the past few seasons shows lithium salts always to be absent, though there remains the possibility that they may be present in the case of sugars produced from beets grown on certain soils, since this element has been found to occur sporadically in the mineral matter from roots. Fifty grms. of sugar containing quantities of lithium carbonate varying from 0·005 to 0·0000312 per cent. were incinerated (without the addition of sulphuric acid), and the ash obtained from each was examined spectrometrically, when it was found that with the 0·000125 per cent. mixing the characteristic lithium line was distinctly visible, being indeed fairly clear with only 0·000625 per cent. Assuming 0·0001 per cent. as the smallest addition which can be identified with certainty, this corresponds to only 1 grm. of lithium carbonate per ton of sugar, or 1700 kg. for 1½ million tons, which latter amount would cost according to a recent quotation 28,000 gold marks. Other "very considerable costs," it is considered, would be involved in the mixing of the sugar with the lithium carbonate, re-sacking the sugar, and examining it spectroscopically. Spraying a solution of lithium salt upon the sugar in the centrifugals is pronounced as impracticable owing to the large loss which would result, and a special mixing apparatus to effect thorough incorporation without loss would have to be devised.

POSSIBLE SOURCE OF ERROR IN THE POLARIZATION OF SUCROSE IN THE FORM OF FINE POWDER. *Georg Jaeckel.* *Vereinszeitschrift, 1923, 118-119.*

During the course of his investigations on the cause of sugar dust explosions,[3] the author made the observation that when sugar is very finely ground the particles formed have the property of adsorbing gases, air for example. This he demonstrated by grinding sugar crystals to a fine powder in a laboratory ball mill in a hermetically closed chamber provided with a gauge, when, after 24 hours, a reduced pressure corresponding to 23 mm. of mercury was indicated. This can only be explained by the adsorption of air on the newly formed surfaces of the particles of sugar dust. He points out that, since when polarizing such very fine sugar the film of condensed air thus formed is included in the weight taken for the determination, this must explain the mysterious small deviations in the specific rotation of sucrose which have been noticed by different investigators from time to time, for the proportion of the film to the weight of the sugar will vary according to the mode of subdivision, the size of the particles, and the degree of dryness of the sample tested.

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[1] *Deut. Zuckerind.*, 47, 620, 705.

[2] This method is already in satisfactory use for characterizing wine made from the marc of grapes to guard against it being sold as wine fermented normally from the whole fruit.

[3] *I.S.J.*, 1923, 363.

LIMING RAW BEET JUICE, AND SEPARATING THE PRECIPITATE PRODUCED PREVIOUS TO CARBONATING. *Vlad. Skola. Zeitsch. Zuckerind. cechoslov. Republik, 1923, 47, (iv), No. 29, 381-385.*

Raw beet juice was limed in the cold at the rate of 2·0 per cent. CaO, and the resulting precipitate subsided, filtered off, washed, dried, and analysed. It was found to amount to 0·9 per cent. of the weight of juice, or 5·25 per cent. of the polarization of the juice, and had the following composition (calculated on the dry substance): Insoluble in HCl, 0·94; Fe_2O_3 and Al_2O_3, 13·8; CaO, 29·8; MgO, 10·04; P_2O_5, 1·95; nitrogen, 0·705; and loss on ignition, 43·04 per cent. Hence it is seen that this precipitate can hardly be utilized as a constituent for fodder or fertilizer manufacture, as certain chemists have suggested. Of the 2·0 per cent. of CaO used for liming, only 0·26 was present in the precipitate, so that about 13 per cent. of that added had been thrown down, and 87 per cent. had remained in solution. By the formation of this precipitate, 3·9 per cent. of nitrogen and 21·9 per cent. of P_2O_5, calculated on the amount of these constituents originally present in the raw juice, had been eliminated. After separating the precipitate obtained on liming, the clear alkaline juice was neutralized (using HCl), when another precipitate, amounting to 0·515 per cent. of the weight of the juice, or 2·99 per cent. of the polarization of the juice, was produced, this on analysis being found to have the following composition: Insoluble in HCl, 0·17; Fe_2O_3 and Al_2O_3, 9·24; CaO, 34·37; MgO, 0·26; P_2O_5, 7·26; nitrogen, 0·69; and loss on ignition, 58·00 per cent. When this precipitate had been filtered off, it was observed that the colour of the juice had become much lighter, this being found to be due, not to the alteration of the shade as the result of the change of reaction, but to the actual precipitation of colouring matters. Similar experiments on liming and subsiding were made at a temperature of 80°C., and on comparing these results with those obtained with the same amount of lime in the cold it was found that more nitrogen and phosphoric acid had been precipitated at the higher temperature, namely 5·7 and 61·4 per cent. respectively, as compared with the figures above stated, viz., 3 9 and 21·9 per cent. In addition to these tests, some experiments were made in which the lime was added in two successive fractions, when it was found that somewhat more nitrogen and phosphoric acid could be eliminated, namely 6·9 and 75·1 per cent.

CLARIFICATION OF BEET JUICE BY CARBONATATION, THE LIME PRECIPITATE HAVING PREVIOUSLY BEEN SEPARATED. RESULTS OF EXPERIMENTS ON RAW BEET JUICE FILTRATION USING A MECHANICAL FILTER, AN ELECTRO-OSMOTIC DRUM, AND A SACEK CENTRIFUGAL MACHINE. *Vlad. Skola. Zeitsch. Zuckerind. cechoslov. Republik, 1923, 47, Nos. 37, 38, 39, 475-479, 483-488, 491-495.*

In the literature on the clarification of beet juice, the view has been expressed that if the juice be treated with a small quantity of lime (about 0·2 per cent. of the roots), and the resulting precipitate separated, then the subsequent clarification of the clear juice by the carbonatation process is easier, and less additional lime will suffice than in the ordinary procedure. This the author is not able to confirm. On the contrary, a much better clarifying effect (in respect of purity, colour, and calcium content) is obtained when the juice is carbonated in the presence of the lime precipitate, which evidently plays some part in adsorbing impurities.

A good deal of attention was given in this research to the question of the removal of the precipitate obtained on the addition of a small amount of lime, previous to ordinary carbonatation, the methods tried being: subsiding, mechanical filtration, electro-osmotic drum filtration, and centrifuging. Subsiding on the whole appeared the most practical procedure, the best results being obtained when the precipitate was allowed to settle from the heated liquid, its volume after one hour being 13-15 per cent. Mechanical filtration could be applied only with difficulty, and it is suggested that the most likely way of improving the operation is to use a vacuum apparatus, employing a low suction, and regenerating the filtering surface at intervals by blowing compressed air through it, which method is believed to be capable of giving better results than ordinary high pressure

filtration. So-called "electro-osmotic filtration," using the drum apparatus of the Elektro-Osmose A.-G., of Berlin, was not found to give satisfactory results (the terminal voltage varying between 12 and 17, and the amperage between 3 and 4), it being found that the temperature of the juice was raised to a high degree during the operation with the production of much froth. The author considers that the process is not practically applicable, because: (1) In addition to the electro-osmotic phenomenon an electrolytic action proceeds at the same time, so that in comparison with the small amount of scum which is separated the amount of current demanded is out of all proportion; and because (2) the water of the liquid is decomposed, much gas is liberated, and an explosive gaseous mixture is formed as the result of the electrolysis taking place. In fact, it is pointed out that, owing to its content in salts, the nature of the juice is such that an electrolytic process is favoured, whereas the conditions for an operation which is largely electro-osmotic are a low electrical conductivity and a high voltage. Lastly, centrifuging was tried, using the Sacek machine, but these experiments were unsatisfactory, the actual operating capacity of this particular type of apparatus being impracticably small.

MARC ALLOWANCE IN THE DETERMINATION OF SUGAR IN BEET COSSETTES BY PELLET'S METHOD. *S. J. Osborne.* *Journal of Industrial and Engineering Chemistry. 1923, 15, No. 8, 787-788.*

In Pellet's hot water digestion method, 26 grms. of the cossettes are made up to 200·6 c.c., the 0·6 c.c. being the allowance as generally prescribed for the insoluble matter or marc. PELLET[1], however, re-determined the value, and concluded that 0·8 c.c. would be a more accurate figure. Working with Colorado and Nebraska beets of the 1922–23 campaign, and using Claassen's method[2] for determining the marc, the value 0·6 c.c. was found. But an allowance should be made, not only for the marc, but also for the lead precipitate, which was ascertained to be 0·3 c c., making a total allowance of 0·9 c.c. Since during the 1922–23 campaign, the marc content of the roots was somewhat low, the total allowance should be taken as 1·0 c.c. If the flask were graduated at 201 c.c., instead of at 200·6 c.c. as at present, the polarization of a 16 per cent. beet would be lowered to the extent of 0·03°. Although the error with the present allowance is almost negligible, there is no reason why the cossette flask should not be re-graduated to conform with the data now established.

STARCH CONTENT OF SORGHU JUICE, AND ITS INFLUENCE ON JELLYING. *Sidney F. Sherwood.*[3] *Journal of Industrial and Engineering Chemistry, 1923, 15, 727-728, 780-782.*

In the case of a raw sorghum juice of good quality its content in starch, sucrose, and reducing sugars is: 3·3 to 7·8; 13·58; and 2·03 per cent. respectively for the three constituents. That portion of the starch which escapes elimination by clarification and finds its way into the finished syrup is responsible for the so-called "jellying" of sorghum syrup; and starch appears also to be a cause of the difficulty in filtering the raw juice, especially after it has been heated. The writer describes small-scale experiments which would demonstrate that the preliminary treatment of the raw juice with the enzyme diastase for the saccharification of the starch overcomes the difficulties alluded to above; and he suggests that this modification may be applied with great advantage to the commercial production of sorghum syrup.

METHODS FOR THE PREPARATION OF RARE SUGARS [ARABINOSE, RHAMNOSE, XYLOSE, GALACTOSE, MELEZITOSE, RAFFINOSE, AND MALTOSE]. *T. Swann Harding.* *Sugar, 1922, 406; 1923, 80-83, 124-125, 175-176, 240-241, 308-310, 350-352.*

Previous work done on the preparation of these sugars is summarized, and to this information are added the methods preferred by the author.

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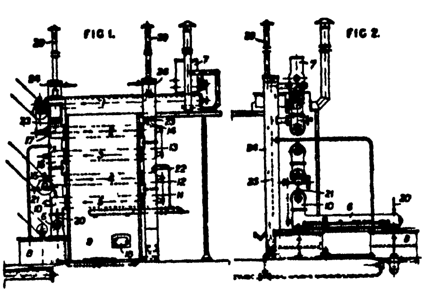
1 Browne's "Handbook of Sugar Analysis," p. 246. 2 *Zeitsch. Ver. deut. Zuckerind.*, 1906, 56, 912.
3 Of the Bureau of Plant Industry, Department of Agriculture, Washington, D.C., U.S.A.

Review of Recent Patents.

UNITED KINGDOM

MANUFACTURE OR REGENERATION OF ACTIVE (DECOLORIZING) CARBON. *Algemeene Norit Maatschappij (General Norit Co., Ltd.)*, 2, Den Texstraat, Amsterdam, Holland. *198,328* January 13th, 1923 ; convention date, May 26th, 1922.

A process for producing uniformly active charcoal, or for regenerating spent charcoal, of the type in which a carbonaceous material is distilled in the presence of active gases[2] is characterised in that the raw material, which may be the less porous kinds of coal and carbonaceous materials such as brown coal, anthracite, etc , is first granulated or pulverized preferably uniformly and then agitated during the heating and action of the activating gases, the agitation being effected for example by stirring, by rotation of the retort, or by the kinetic action of gases The raw material may be subjected to preliminary dry distillation in which the products of distillation are quickly swept away, such as by the passage of practically inert gases. The activating gases specified are steam, carbon dioxide, carbon monoxide, air, oxygen, chlorine, hydrogen, flue gases and generator gases ; and an apparatus for carrying out the process in a continuous manner consists of a hopper *7* with automatic feed mechanism, which charges the material to a trough *1* with a worm conveyor, whence it passes successively to retorts *2-6* of fireclay or a refractory alloy, all of which have worm conveyors. Retorts *2-5* are disposed within the brick walls *9* of a furnace *18* the unions *10* and *17* being exposed. Gases may be blown into the retort *6* at *20*, into *5* at *21*, and into *4* at *22*, the retort gases passing by outlets *23* to wide pipes *24*, divided by partitions *25*, and having water-chambers at their bases to collect suspended carbon, and chimneys *29* An example shows the production of active charcoal using already carbonized material, air preferably diluted with nitrogen being admitted to retort *6*, flue or generator gases to retort *5* and steam to retort *4*, the injection beginning as soon as material makes its appearance at the water-sealed or enclosed chamber *8* into which the finished product is delivered In a further example, finely powdered charcoal is maintained in a floating state in an externally heated retort by means of active gases either alone or mixed with inert gases. Again in this method a series of retorts, or of zones, in which there are different gases and different temperatures, may be employed.



SECURING INTIMATE CONTACT OF LIQUIDS AND GASES (E G., IN THE CARBONATATION PROCESS OF CLARIFICATION) *Colorado Iron Works Co.*, of Denver, Col., U.S.A. *197,978*. November 23rd, 1921. (Five drawings ; six claims.)

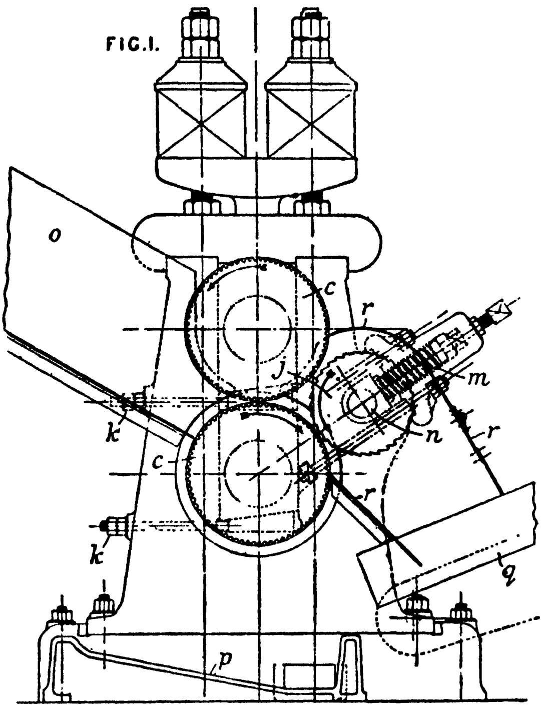
An apparatus and process for securing the intimate contact of liquids and gases, stated to be useful for carbonating a saccharate solution, is described. In it a rotor, mounted on a shaft and rotating in a liquid-containing chamber, is provided with spiral vanes which segregate and draw gases and liquid toward the axis of the rotor. The rotor has an axial discharge for the gases and liquid directly into a body of liquid in an adjoining chamber, and a screen is provided concentrically mounted on the shaft and rotating therewith and forming a tubular extension of the rotor, the gases and liquid passing from into the discharge chamber through the screen. In some cases a second annular screen may be provided in the discharge chamber

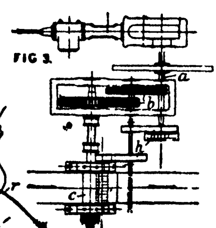
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s each) *United States*· Commissioner of Patents, Washington, D.C. (price 10 cents each) *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each)

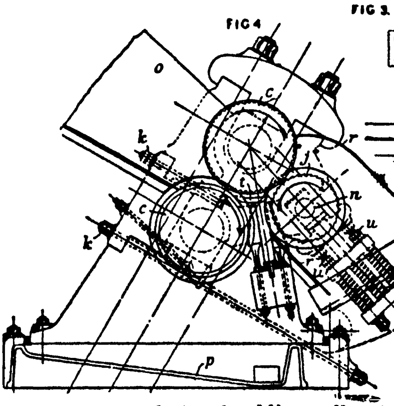
[2] *Cf* also U.K. Patent, 189,148 , *I S.J* , 1923, 166.

CANE CRUSHER AND SHREDDER, *Francis Maxwell*, of 11, Park Avenue, Wallington, Surrey. *198,120*. March 14th, 1922. (Five figures; three claims.)

A machine is described for crushing and shredding cane, comprising a pair of pressure rollers with means for adjusting their relative positions, with or without pressure-regulating gear, and a third shredding-roller working in conjunction with one of the pressure rollers with pressure-regulating gear. A trash-turner may be provided to direct the crushed cane issuing from between the pressure rollers to pass between one of the pressure rollers and the shredding-roller. As shown in Figs. 1 and 3, the crushing or pressure rollers *c* are driven through reduction gearing *b* from a shaft *a*, and the shredding-roller *j* is driven at high speed by belt gearing *h* from the shaft *a*. Wedge adjusting devices *k* are provided to vary the distance between the rollers *c*, and spring-pressure devices *m* for moving the water-cooled bearings *n* of the roller *j* towards one of the rollers *c*. The sugar cane is passed down a shoot *o* and after being crushed by the rollers *c* is shredded by the high-speed roller *j*. A casing *r* confines the shreds of cane, and delivers them to a conveyor *q*, while a trough *p* catches the juice expelled from the cane by the rollers *c*. The top crushing-roller is placed vertically above the other, and the lower crushing-roller acts as an abutment for the shredding-roller. But in a modification, Fig. 4, the crushing rollers *c* are set at an inclination, and the crushed cane is guided by a trash-plate *t* to pass between the upper roller *c* and the shredding-roller *j*. The spring devices *m* press the bearings *n* towards the upper roller *c*, and by adjusting the nuts *u* the opening between the shredding-roller and the upper roller *c* can be regulated. One of the crushing rollers may have a circumferentially-grooved surface, or it may have zigzag circumferential gutters as







described in Specification 17534/15,[1] and the other crushing-roller is provided with teeth or projections and grooves of any known form. The toothed shredding-roller may be formed of discs assembled together.

ROTARY FILTER WITH DRUM HAVING POROUS METAL STRUCTURE. *Plauson's (Parent Co.), Ltd.*, of Pall Mall, London. *199,353.* April 10th, 1922.

A rotary filter drum comprises a porous metal structure having circumferential ribs of strong metal flush with the surface in order to protect the surface from destruction by a scraper knife. The drum shown in the figure accompanying the specification is formed of wire wound circumferentially on a perforated member. A vessel contains the material to be filtered. The filtered liquid is withdrawn by suction through pipes, a stationary sleeve, the hollow shaft, and a pipe. Spraying jets are mounted in an extension housing. The pores of the drum may be constricted by the precipitate itself, by allowing cementitious material (for example, gypsum, or cement made with salt) to set therein, by the galvanic deposition of metal, or by means of an aqueous suspension of asbestos meal or other fibrous or porous material. They may be further constricted by impregnation with a colloid such as a rubber solution. Wire which has been covered with finer wire or yarn may be used.

INDICATING MECHANISM FOR WEIGHING APPARATUS. *K. Schember and R. Joksch*, of Karolinenthal, Prague, Czecho-Slovakia. *199,699.* April 18th, 1923; convention date, June 22nd, 1922.

Weighing apparatus (e.g. of the crane type) is controlled from a distance by mechanical connexions, and the balance or otherwise is indicated to the operator at the distant station by electrical means, so that he may observe and record the result of the weighing. Apparatus is also described for giving printed records of the weight observed.

PRODUCTION OF VEGETABLE DECOLORIZING CARBON. *L. H. Bonnard*, of Ealing, London, W. *199,751.* December 31st, 1921.

Vegetable material, preferably of fibrous character, for example sawdust or peat, is comminuted and intimately mixed with slaked lime and heated in a retort to a temperature of about 1000°C. until carbon monoxide ceases to be evolved, when the temperature is maintained for a further shorter period. Mixing with lime is preferably facilitated by the presence of a small proportion of water. According to examples stated, equal weights of sawdust and water are mixed with calcium hydroxide in a ball or edge-runner-mill, and then heated to about 1000°C. in a retort, preferably that described in Specification 196,958, the period of further heating varying with the amount of lime. After cooling, the lime may be again slaked and the whole submitted to a further heat treatment. Chalk may be used instead of lime, but in this case the second heat treatment is essential. By-products from the distillation are collected. Specifications 10622/15, 124,638, and 167,195 are also referred to.

CLARIFICATION OF MOLASSES FOR THE PRODUCTION OF YEAST CULTURES. *Vereinigte Mautner'sche Presshefe Fabriken Ges.*, of Vienna, Austria. *196,926.* April 26th, 1923; convention date, April 29th, 1922.

Molasses to be used in making a culture-medium for yeast is clarified by forming in them a voluminous precipitate produced by the action of ammonia on calcium phosphate. Superphosphate is dissolved in the diluted molasses, and the precipitate produced by aqueous ammonia.

MANUFACTURE OF ULTRAMARINE BLUE. *E. F. Kur and F. Wilkinson*, of Dudley Hill, Bradford. *198,212.* May 26th, 1922.

Ultramarine is formed by heating to 700–1000° C. a mixture of calcined china-clay and an alkali polysulphide, other than a polysulphide of ammonia. In an example, 30–40 parts of calcined china-clay, free from iron and lime, are mixed with 15-30 parts of sodium trisulphide and the mixture heated for at least 6 hours.

[1] *I S.J.*, 1916, 290.

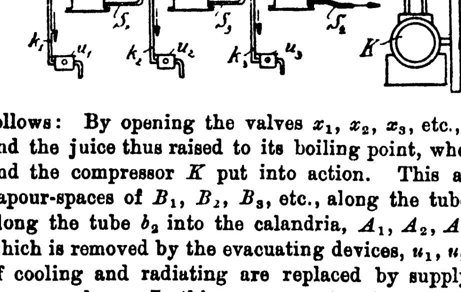
Purifying Liquids with Precipitated Lime Salts, Decolorizing Carbon, Animal Charcoal, Kieselguhr, etc. *J. N. A. Sauer*, of Amsterdam, Holland. *198,374*. May 26th, 1923; convention date, May 26th, 1922.

A modification of the process for purifying liquids described in Specification 183,485[1] consists in treating the liquid simultaneously or successively with externally precipitated lime salts and with some other purifying medium such as decolorizing carbon, bone charcoal, blood charcoal, kieselguhr, fuller's earth, kaolin, or silicic acid. Liquid to which these materials have been added may be heated and the materials subsequently removed by filtration. The process is applicable in the treatment of sugar solutions, glucose, invert sugar, vegetable and fruit juices, glycerine, water, oils, fats, benzine and petroleum. The treatment may be followed by a chemical treatment, for example treatment with lime, and saturation with carbonic or sulphurous acid.

CZECHO-SLOVAKIA.

Multiple Effect with Thermo-compression. *Josef Hrebicek*, of Hodolany, Mahren, Bohemia. *4471*. May 24th, 1923.

It is explained in the preamble of this specification that the barometric condenser is an uneconomical accessory of the multiple effect evaporator, because it absorbs the latent heat from the last vessel without any useful effect, consumes a large amount of cooling water, and also makes the entrainment of juice possible. It is done away with in the present invention. Referring to the drawing, I, II, and III represent the several vessels of a multiple effect evaporator, here shown as a triple, which vessels are of the same size as at present generally constructed. B_1, B_2, and B_3 represent the juice-spaces, which are connected by vapour pipes, S_1, S_2, S_3, and S_4, the calandria, A_1, A_2, A_3, etc., being connected by drain-pipes k_1, k_2, k_3, etc., to pumps or other evacuating devices, u_1, u_2, u_3, all of which parts are to be found in any modern apparatus. But the accessory which is novel is the low pressure compressor K, which by means of the tube b_1 is connected with all the juice spaces, B_1, B_2, B_3, etc., and through b_2 with all the calandria, A_1, A_2, A_3, etc. Moreover, there is a line supplying fresh vapour, a, which is connected with the several calandria by valves, x_1, x_2, x_3, etc. In operating the new evaporating plant, one operates as follows: By opening the valves x_1, x_2, x_3, etc., fresh steam is let into the calandria, and the juice thus raised to its boiling point, whereupon each of the valves is throttled, and the compressor K put into action. This accessory sucks the vapours from the vapour-spaces of B_1, B_2, B_3, etc., along the tube b_1, and after compressing it sends it along the tube b_2 into the calandria, A_1, A_2, A_3, etc., where it is condensed to water which is removed by the evacuating devices, u_1, u_2, and u_3. Losses of heat as the result of cooling and radiating are replaced by supplying fresh steam through the valves x_1, x_2, and x_3. In this new apparatus the aim in view is to operate with as low a vapour compression as possible, and with a low temperature fall between calandria and heating space as possible. A minimum amount of mechanical power is consumed in the working of the compressor K; and the formation by the compressor of superheated steam unsuitable for condensation is avoided. A weak compression and small fall of temperature are realized in the new design by maintaining in all the vessels such a relationship of temperature as prevails in the first vessel of the present type of multiple effect evaporating plant.

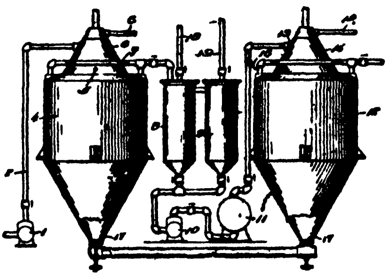


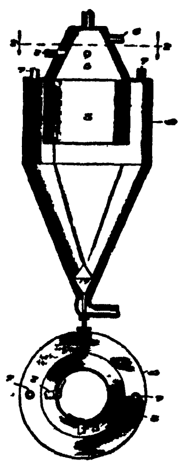
[1] *I.S.J.*, 1923, 273.

UNITED STATES.

CLARIFICATION OF CANE JUICE.[1] *Edward J. Ruckstuhl*, of Levert, Louisiana, U.S.A. *1,201,104*. October 10th, 1916. (Three figures; one claim.)

Cane as delivered at the mill contains a considerable quantity of wax in the form of gummy deposits on the rind and joints of the stalks. Liming and heating of the juices as they come from the mill cause the lime to combine with the vegetable waxes and cellulose and form an emulsion which, after being heated, will require mechanical filtration to remove. It will be readily appreciated that after removing about 80 per cent. of the wax before heating, defecation will be rendered comparatively easy, and the juice will be improved, in addition to which there is the recovery of the wax as a by-product. In carrying out the process by which this removal of wax, etc., may be effected, raw juice as it comes from the crushing apparatus or after being subjected to the action of sulphurous acid fumes is supplied to a pump *1* by which it is forced under pressure through a conduit *2* and past non-return means, so that it enters at a high velocity the collector *3* of a separator *4*. Said collector *3* is preferably of conventional construction. Compressed air is also injected into the collector *3* at the point *5* from a suitable source of supply (not shown), this giving rise to a mechanical agitation which causes the formation of a foam on the raw juice. The foam leaves the separator at *6*, with the wax, gum and fibre, while dirt-free juices leave the separator at *7* and pass to a receiving tank *8* for treatment of milk-of-lime. From the tank *8*, the juice overflow to tank *9* which is provided for the neutralization of any excess of lime by carbonic or phosphoric acid. The juices supplied to pump *10* are conducted to a heater *11* in which they are heated to 200° F., after which they pass to the separator *12* and enter the same at the point *13* of the collector *14*. Here the remaining fibre, air, and light substances are removed at the point *15*; the dirt-free juices leaving at the point *16* from whence they pass to the evaporating apparatus, while the heavy substance or substances leave at the points *17* of the two separators and pass to filter-presses or the like (not shown). At *18* and *19* are shown lime and air pipes for use in the thorough mixing of the juices. It is manifest that subsequently to the passage of the foam containing wax, gum and fibre from the separator *4* at the point *6*, wax and gum may be separated from the other substances and each other and recovered in the ordinary well-known manner or any other suitable manner.



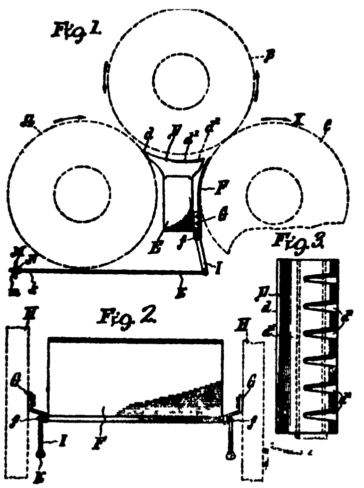


JUICE SAVING ATTACHMENT FOR CANE MILLS. *James Fisher*, of New Orleans, La, U.S.A *1,456,430*. May 22nd, 1923. (Three figures, three claims.)

D represents the turn-plate mounted upon any suitable support *E*, and provided with a scraper edge *d*, its top *d'* being in the form of a curve with a series of grooves d^2 on the rear portion thereof (as shown in Figs. 1 and 3). *F* represents the deflector plate which is preferably curved as shown in Fig. 1, and is pivoted, as at *f*, to the brackets *G* (see Fig. 2

[1] See also U S Patent, 1,060,498, April 29th, 1913, same inventor.

which are connected to the mill-housing *H* in any convenient way. This deflector plate *F* is regulated by the crank arms *I* to which the rods *K* are pivoted. These rods are screw-threaded, as at *k*, to engage the screw threads on the hub *m* of the hand-wheel *M*, which engages a suitable stop *N* attached to any convenient portion of the mill-housing. It will be seen that this curved plate *F* will fit snugly against the bagasse roller *C*, and may be pressed against the same by setting up on the hand-wheel *M*. Since the bagasse roller rotates in the direction of the arrow *X*, there will be no pressure on this plate *F* except that applied by the hand-wheel *M*, and the occasional passage of small particles of bagasse or other material which may adhere to the surface of the bagasse roller after it has nearly completed a revolution from the turn-plate. Such particles would be very small, and could do no more harm than press the deflector plate outwards slightly, which movement would be readily permissible owing to the flexibility of the various parts of the device used in pressing this deflector plate against the bagasse roller. In fact the principal need for the adjusting hand-wheel *M* would be to apply the deflector plate properly in the first instance, and to compensate for any subsequent wear on either the plate itself or on the roller. It will be seen that any free juice falling over the grooved edge of the turn plate will fall on this deflector plate and will be guided down to the juice pan (not shown) which is provided in mills of this character. Of course any free juice contained in or which adheres to the bagasse as it passes over the turn plate will be subjected to the second crushing just referred to, but by the present invention any free juice that passes over the turn plate will not come into contact with the bagasse roller at all, and will fall freely down between the receiving roller and the bagasse roller to the juice pan, and will then be carried off to the juice tanks or other apparatus well known in the art.



Production of Charcoal and By-products. *Stanley Hiller* (Assignor to *Pacific By-Products Co.*, of San Jose, Cal., U.S.A.). *1,458,410.* June 12th, 1923.

Claim 1.—An apparatus for producing charcoal comprising an inclined rotary cylinder having heads at its ends, a spout and hopper through which the material is supplied into one end, a fuel nozzle at the same end as the spout and hopper, means for rotating the cylinder for causing the material to travel in the same, whereby the material is first passed through the flame from the nozzle and subsequently subjected to a non-inflammable heat,, means for controlling the oxygen admitted at the end of the cylinder at which the nozzle is arranged, and suction, scrubbing and condensing means connected with the drum.

Conversion of Barium or Strontium Carbonate or Sulphide into the Corresponding Hydrate *Ralph W. Shafor*, of Denver, Colo., U.S.A. *1,460,180.* June 26th, 1923.

Barium carbonate or sulphide is treated with hydrochloric acid, and the resulting chloride solution treated with sodium hydrate to precipitate barium hydrate and form a sodium chloride solution (carrying a small proportion of alkali earth salts) which latter is electrolysed to produce sodium hydrate, chlorine and hydrogen, these two elements uniting to give hydrochloric acid for the continuation of the cycle of operations.

Crushers for Cane Mills.[1] *Henry Hurter* (assignor to *Fulton Iron Works, Company*, of St. Louis, Miss., U.S.A.). *1,451,164.* April 10th, 1923.

[1] Already noticed; see U.K. Patent, 162,975, *I.S.J.*, 1921, 534.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922. Tons.
Total Receipts, January 1st to August 29th	2,181,512	..	2,977,890
Deliveries ,, ,, ...	2,167,215	..	2,933,132
Meltings by Refiners ,, ,, ...	2,061,960	..	2,788,573
Exports of Refined ,, ,, ...	195,000	..	700,000
Importers' Stocks, August 29th	14,297	..	44,758
Total Stocks, August 29th	117,471	..	191,332
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1920-21 Tons.		1921-22. Tons		1922-23. Tons.
Exports	1,602,897	..	2,851,391	..	2,746,613
Stocks	1,410,886	..	640,464	..	519,996
	3,013,783		3,491,855		3,266,609
Local Consumption	75,000	..	87,500	..	77,500
Receipts at Port to June 30th	3,088,783		3,579,355		3,344,109

Havana, July 31st, 1923. J. GUMA.—L. MEJER.

Sugar Crops of the World.

(Willett & Gray's Estimates to July, 1923.)

	1922-23. Tons.		1921-22. Tons.		1920-21. Tons.
CANE.					
America	6,778,637	....	6,904,287	.	6,614,271
Asia	5,410,675	....	4,927,236	. ..	4,613,094
Australasia	358,678	. ..	364,465	....	240,401
Africa	564,411	....	542,624	...	576,126
Europe...........	6,000	....	5,000	. .	6,886
Total Cane.........	13,118,401		12,743,612		12,050,778
BEET.					
Europe..................	4,510,704	....	3,996,707	....	3,681,461
U.S.A..................	615,936	....	911,190	....	969,419
Canada.................	12,400	....	18,931	....	34,600
Total Beet	5,139,040		4,926,828		4,685,480
TOTAL CANE AND BEET..	18,257,441		17,670,440		16,736,258

THE

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☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 298. OCTOBER, 1923. Vol. XXV.

Notes and Comments.

The Sugar Market.

The sugar market which was upset in the Spring by speculations arising out of a panic due to indications of severe crop shortage, and suffered temporary setbacks during the summer owing to the realization of weak bull holdings, has now settled down to an admission of the strength of the producers' position, and prices are not likely to drop before the new crops are in full swing. Cuba has finished her campaign 400,000 tons below original estimates, the prospects on the Continent of a big beet harvest have been damaged by the drought, the latest estimate being some 300,000 tons less than the earlier ones, while the earthquake in Japan is reported to have destroyed 100,000 tons of sugar. The Java crop is all sold, the last portion having been sold to the Scandinavian countries. It is clear, then, that consumption is well ahead of production and that for the producer a continuation of remunerative prices is assured for a considerable while yet. America which is now the biggest consumer has persisted in a hand to mouth policy for buying for months past; her invisible supplies in consequence must be on the low side. The immediate question would hence appear to be: what sort of balance will be struck between an increased demand this side of Christmas and a deficient supply with rising prices?

While on the subject of sugar markets, we take pleasure in announcing that our monthly sugar market report which was perforce discontinued early in the year owing to the loss within a short while of two successive correspondents, is being resumed with this issue, and we trust will continue uninterruptedly in future issues. While we do not pretend to compete in this respect with daily or weekly reports issued by the sugar trade or the commercial press, we have no doubt that a monthly resumé of the course of the sugar market is of use not only to those of our readers whose occupation does not call for continuous study of the market situation but who like to be kept informed of its general trend; it should also be of value as an accessible record to those who wish to scan the operations of past days without wading through the voluminous and unindexed pages of the regular market reports.

The Cuban 1922-23 Sugar Crop.

The 1922–23 sugar crop in Cuba has produced, according to Guma & Mejer's final figures, a total of 3,602,910 long tons, or some 400,000 less than was estimated a year ago. This decrease, which is also in round figures the extent of the reduction on the 1921–22 crop, is due in part to a severe drought in the eastern end of the island, and in part to the continued financial stringency which prevented many farmers from giving the necessary attention to their canefields in the shape of tilling and fertilizing. Writing at the beginning of September, our Havana correspondent reported that a little over 2,900,000 tons had already been exported, leaving some six or seven hundred thousand tons available for export between then and the new crop in December. This amount is equivalent to about 35,000 tons shipped per week and is not more than the United States may require. Hence, any demand from Europe, however small, will have the effect of firming prices, and in any case the indications are that the price of sugar from now on will be maintained at or above its early September figure.

Our same informant states that it is quite impossible at this stage to give a close estimate of what the next crop will amount to, since so much depends on the rainfall from now onwards. However, any review of the conditions at present existing suggests that the coming crop will be bigger than the past one. With the exception of Eastern Cuba, where the weather is still too dry for good growth, ample rains have fallen in most districts. The new plantings have been quite extensive all over the country and fertilizers have been bought and applied in large quantities. Money is not as tight as it was last year, and the farmers are making great efforts to cultivate adequately their canefields. These facts indicate a good increase for the next crop, always providing good growing weather prevails.

Economic and Political Affairs in Cuba.

Elsewhere will be found a short article describing a trend in Cuba which is becoming increasingly marked. The big American interests in the island, aided by their U.S. banks, are extending their grip on the sugar lands, present and prospective, and are endeavouring to secure a monopoly of production in a large section of the island. Mutual understanding between them results in their respective spheres of influence being respected so that a certain type of competition is eliminated. This is a natural result of the financial stringency that seized the island in 1920–1921; American banking interests came to Cuba's rescue, but at a price—which is apparently taking the form of securing for those interests or their clients a commanding hold in the Cuban sugar industry. The one loophole of escape appears to lie with the Cuban sugar growers who, it is pointed out, may unless they are well paid for their cane prefer to combine and erect their own crushing and manufacturing installations, in which case there would be some reversion to mills of moderate dimensions. It is not likely that the Cubans will lightly acquiesce in America once more dominating their industry; but to a large extent their best hope of salvation would appear to lie in putting their finances as speedily as possible in a sound condition, and in maintaining so stable and equitable a form of Goverment that there is no excuse for the United States to interfere politically, as she has had twice to do in the past and has some grounds for doing in the near future. Just lately Cuba has given the American Government cause for anxiety; the situation (as summarized in a recent leading article in the *Times*) lies in the fact that Cuba a few months ago secured a loan of fifty million dollars from the United States on condition, *inter alia*, that she should balance her Budget, abolish her lottery, and respect the rights of foreigners.

But having pocketed the cash, she is in no hurry to carry out the conditions. The American President is determined to make Cuba observe the promises on the strength of which she obtained the loan. If the Cuban Government do not voluntarily comply, then the American Government may be forced to resort to the ample powers of intervention that they retained when in 1901 they transferred by treaty the Government of Cuba to the Cubans. It is to be hoped, as the *Times* remarks, that the Cubans will not be so unwise as to compel America to vindicate her treaty rights by measures she would be reluctant to adopt, but which she can and will adopt should the necessity arise.

Obviously every occasion when America has to intervene with Cuba is an incentive to curtail, if not to put an end to, Home Rule for Cuba. Intervention must tend to strengthen America's commercial hold on the island, and the sugar monopolists amongst others would only reap a further advantage. Whatever be the feelings of the American consumer in the matter, the rest of the sugar-consuming world certainly does not want the Cuban sugar supply to become the subject of a giant American monopoly, so one trusts that those Cuban administrators who value the independence of their island will see to it that the present cause of political friction with the United States is removed.

Home Beet Sugar Projects.

The continued remission of the excise duty on sugar has developed confidence in the ability to work our home beet sugar industry profitably in its earlier stages, and this year at least 150,000 tons of roots are being grown for the two sugar factories. A third factory seems now assured of projection; the Kidderminster scheme already referred to (page 394) has developed sufficiently to warrant the hope that the proposed factory in that district will operate a year hence. Of the required sum of £350,000, promises of £205,000 have already been received and provisional arrangements for the supply of the factory machinery and expert assistance for the manufacturing operations have been made. Farmers in the district have been asked to promise 5000 acres on a beet contract for three years, such farmers to have preference of allotment of shares in the proposed company.

Imperial Preference.

The British Empire Producers Organization, which represents in Great Britain the principal primary producing and manufacturing associations throughout the British Empire, has lately prepared a Memorandum on Empire Preferences, Development of Empire Resources, and the Necessity for Continuity of Work of the Conference, for submission to the Imperial Economic Conference, which is meeting this month in London. Discussions have taken place amongst the various Industrial Sections of the Organization and the opinion now expressed by the Memorandum in question is claimed to be the carefully considered opinion of the great producing communities in the Empire overseas.

In the matter of Empire Preference, the Organization lay it down that the basic principle of any Imperial economic policy that will provide fuller employment for the people of the Empire and tend to make the separate units more self-supporting is that of a system of intra-Empire preferences, both tariff and otherwise, and that as the United Kingdom is the only large market open to the Dominions and Colonies for the sale of their food products and raw materials, some substantial system of preferences must be evolved that will provide a first advantage to the home producer and a second advantage to the overseas Empire producer, and thus encourage Empire production and free the British consumer from the present manipulation of foreign trusts resulting in high prices.

The Organization also strongly urges upon the Conference that the first essential to a successful Empire agricultural development is the co-ordination of food supplies upon a whole-Empire basis which would go a long way to freeing Great Britain from the domination of foreign trusts and combines that already control our food supply and can at will raise or depress prices, a menace alternately to producer and consumer, and in the long run to both, the greatest desideratum in regard to food supplies being reasonable prices maintained steadily at approximately the same level over long periods of time.

The Case for Sugar.

As regards the case of sugar, the Organization's memorandum points out that the most serious factor in the Empire sugar situation, in so far as it affects the consumer in this country, is that the prices are at the mercy of foreign combinations of sugar interests which have been built up wholly on a highly protected industry. The German sugar beet industry with its system of bounties almost exterminated the Empire producer of cane sugar, and since the Cuban War the Americans by organizing and protecting with very heavy duties the cane sugar industry of Cuba and the American Colonies, have assumed the control of the sugar markets formerly enjoyed by Germany. The claim made for the sugar industry is that the present preference accorded in the British tariff of one sixth of the full duty (that is one sixth of 25s. 8d. per cwt. of sugars exceeding 98° of polarization) should be fixed at a money value preference (the industry would suggest 8s. 6d. per cwt.), and that the amount of the preference should be unaffected by any reduction in the gross duty, and that this amount should be guaranteed as far as it was in the power of the British Government to do so for a period of 10 years.

It is impossible to obtain the necessary capital for the development of an industry such as cane sugar, which takes at least two or three years to come into active operation, unless some assurance for the future exists, and it is essential, if the Empire is to enjoy adequate supplies of sugar at reasonable prices, that the industry should be kept alive in the face of highly subsidized and protected foreign competition. United States and American Colonial sugars pay no duty in the United States, and thus have a preference of 8s. 1d. per cwt. over Cuba, and 10s. 1d. per cwt. over British Empire sugars. In France the full duty is 100 francs per 100 kilos. The French Colonies pay half and thus get a preference which at pre-war rates of exchange (25 francs to the pound) works out at a preference of about 40s. per cwt. The present British Empire preference, as has been seen, amounts only to under 4s. 4d. per cwt. on pure sugar and about 3s. 9d. on the sugar of the standard level to which the above figures for America and France apply.

Incidentally, it is pointed out that the sugar imports into the United Kingdom in 1922 were 1,983,000 tons, of which the United States and Cuba supplied 902,000 tons and the British Empire 300,000 tons.

British Alcohol.

The British Empire Producers Organization also urges upon the consideration of the Conference the importance of encouraging the production of alcohol fuels in every part of the Empire and thus help to free the Empire from dependence on foreign countries for motor spirit supplies which are now so essential to Empire development. South Africa has shown what can be done in this connexion in the way of remission of duties, preference in Government contracts, etc. At the present moment the Empire is practically at the mercy of foreign petrol combines and there can be no real security for the Empire's transport services until every part becomes a producer of at least a substantial part of its motor spirit

requirements. In most of the Dominions and Colonies unlimited suitable raw material exists and in Great Britain enormous supplies can be obtained not only from utilization of waste products, but from growing special varieties of potatoes, a development which would be of the greatest assistance to the agriculturists in the home country.

The production of power alcohol in Germany before the war was an enormous industry which has again been revived, and it is estimated that the production of power alcohol in that country during the present year will exceed ninety million gallons.

The Recovery of Austria.

In his Report on the Economic Situation in Austria, dated July of this year, Mr. O. S. PHILLPOTTS, British Commercial Secretary at Vienna, is able to deal with nearly twelve months' working of the League of Nations' scheme of reconstruction. Austria, he writes, presents a very different picture since the League took its problem in hand. Its currency, though so much depreciated, is now said to be the most stable in all Europe, the deficit on the budget is being greatly reduced with a good prospect of attaining an equilibrium within a couple of years, and the issue of uncovered bank notes has been stopped. Instead of being the weakest point in Central Europe, Austria has become one of the strongest. And this has all been effected at a time when the collapse of the German currency has been unprecedently rapid. American finance has joined with the European for the first time since the war in common action to remedy part of its ravages. Not only has the League of Nations' action been most beneficial in its effect on Austria itself, but it also affords a very significant precedent for solving other equally or still more important problems.[1]

A Prosperous Dutch Sugar Company.

According to a Calcutta contemporary,[2] the "Handelsvereeniging Amsterdam" is the most important sugar producer of the East Indies. During recent years it has become one of the biggest enterprises in Sumatra, where it owns concessions of not less than 200,000 acres. All the profits of this Amsterdam company up to the present time have come, however, from the sugar, the fibre and the tapioca interests in Java. As a general impression of the unique position that the company occupies, it will be sufficient merely to state that its thirteen sugar factories and the twelve enterprises in Java and Sumatra figure in the balance-sheet for nothing. Between 1908 and 1922 this concern, with its very low capital of Fl. 20,000,000 and its open reserves of Fl. 27,000,000, spent out of profits not less than Fl. 35,000,000 for betterments and extension of the sugar factories, while in Sumatra it laid out more than Fl. 25,000,000, and, further, on the Java fibre and tapioca estates more than Fl. 12,000,000 has been written down out of profits. Good management and astute finance lie at the base of this company's great success. In 1922, which was not a good year for sugar, it earned Fl. 6,700,000 with its 3,300,000 piculs, after bringing Fl. 3,700,000 to the profit and loss account for extensions and betterments. With the various enterprises in Java and Sumatra a profit of Fl. 1,200,000 was made—a profit which certainly came only from Java, because Sumatra does not yet earn a penny. The total available profit, including a carry-forward of about Fl. 5,000,000 from the previous year, was Fl. 13,000,000, of which half was credited to various reserve funds, the other half going as dividends of 30 per cent. to the shareholders.

[1] For this summary of the Report in question we are indebted to the *Board of Trade Journal.*

[2] *Commerce,* September 15th, 1923.

Fifty Years Ago.

From the "Sugar Cane," October, 1873.

In this number of our predecessor, an account was given of the process patented by JAMES DUNCAN, JOHN A. R. NEWLANDS, and B. E. R. NEWLANDS[1] for the removal of potash from saccharine solutions, a process which was applied at Clyde Wharf Refinery, near London, and in a number of sugar-houses in this country and abroad. It consisted in adding to the cold syrup or molasses sufficient aluminium sulphate to form potash alum, which was separated by centrifuging, and washed with water, in order to free it from the coloured mother-liquor. A good grade of alum in fine crystals, for which at that time there was a good market, could thus be obtained, in addition to which the syrup or molasses separated were almost entirely rid of their potash content, thus permitting a better yield of sucrose in their subsequent working. Further, the plant required was of a simple description; the amount of labour necessary was small; and the entire process was continuous and rapid. It was in operation for some years in various refineries, and proved a practical and remunerative invention.

There were two articles on sugar deterioration, of the causes of which fifty years ago next to nothing was known. One of the writers here commented upon the influence of the atmospheric hygroscopicity, stating that "deterioration is trifling until there is moisture in the atmosphere," he having observed that "sugars on the stancheons keep their colour for weeks, when shortly after a thunderstorm and heavy rains they change colour, and commence throwing off molasses again." The other contributor, C. D. STURGE, made the remark that "in some seasons, the present for instance, there is great complaint of deterioration; in others very little, indicating that the state of the weather, either during the process of manufacture, or whilst the cane is growing, has an important bearing on the question." It was also suggested that the nature of the soil on which the cane was grown might possibly be a factor.

A committee, appointed in Mauritius to examine the measures which should be taken for the extermination of the cane borer, made the following recommendations: (*1*) To burn all the useless remains of the cane with care, perseverance, and unity of purpose; (*2*) to cut away as much as possible all young shoots already attacked; (*3*) to remove the straw or dead leaves from all young cane plantations, cart it away immediately, and burn it with care; (*4*) to put into the ground only such cane plants as are free from insects, and strip them of all their leaves to insure this; and (*5*) to pass such legislative regulations as shall compel all planters to act with unity. It was hoped that with the assistance of these simple measures it would be possible to free cane cultivation in Mauritius from an insect that threatened it with ruin, the committee adding that "this ruin is certain if such measures, or others which experience may hereafter recommend as more efficacious, are not immediately adopted, and carried out with energy."

Then there was a note from a French source announcing the discovery of synthetic sugar by a process which enabled it to be made at about ¼d. per lb., so that "henceforward the manufacture of sugar would be placed in the hands of the maker of chemicals." It was added that the discoverer, a M. JOUGLET [more aptly pronounced juggler], had sold his invention for 1,200,000 francs to a company intending to work it.

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[1] English Patent, 2090 of 1871.

The Cuban Sugar Industry—A Trend.

(From our Havana Correspondent.)

In a previous issue of the *International Sugar Journal* we drew attention to the movement that was then apparent of large Companies and Corporations getting control of the biggest and best sugar producing properties in Cuba. Since then we have had time to see the indications, as outlined in our previous article, go some steps further. The large Companies and Corporations referred to appear to be associated with, in one way or another, some of the largest and strongest banks and refineries in the United States; principally in New York, Boston, and Philadelphia. Such a combination, as is easily seen, can handle the sugar from the canefield to the grocer.

Now these Companies and Corporations have for some time past been gradually consolidating and strengthening their position as regards the supply of raw material—cane—for their raw sugar factories in Cuba. Every means to strengthen their standing is carefully investigated, and the necessary steps then taken to carry out that purpose. Their *modus operandi* is generally as follows.

Where not already done, purchase or control of neighbouring factories has been, and is being carried out, in order to obtain control over a district or territory. Such factories may not necessarily be near to each other; the main point is their location as a controlling factor. The district surrounding their present holdings is carefully examined, and all good cane lands mapped and appraised. If those lands are absolutely controlled by any factory of the Company and most probably that control will remain good for a long number of years, then, perhaps, nothing will be done, and they will be allowed to remain in that situation. But, if there is a possibility of that control being lost in the near future by the advent of some other factory's railroad being extended to those lands, then steps are taken to prevent such control passing into other hands. This may be done in various ways, and the following are the methods generally carried out:—

(*a*) Build a railroad to those lands for the transport of the cane, at the same time making a contract for a term of years with the owner of the lands, whereby he plants the lands with cane and sells the latter to the company at a stipulated price. Such contracts often contain a clause giving the company an option to purchase the lands at or before the expiry of the contract, at a stipulated figure; and they assure the company's factory of a certain area under, or producing, cane for a certain period, and remove the danger of that area falling under the control of some other factory.

(*b*) The other method most frequently adopted is to buy outright the lands in question.

Sometimes areas of good cane land are bought and held as reserve lands for the future. These will not be developed immediately, but will be held as a standby against the time, when—

1. Present lands cease to produce the heavy crops they are producing to-day, and when their productivity has come down to a normal tonnage which will be maintained indefinitely in normal years. Then the reserve lands will be developed to keep up the necessary supply of cane for the full output of the factory.

2. It is decided to increase the present output of the factory, then the reserve lands will be developed to meet the requirements of the enlarged factory.

All this scheme means considerable capital outlay, but it is apparent that the strong combinations described above are in a position to carry out such methods

of acquiring control of large areas of cane land and placing themselves in a very secure position as regards the future cane supply for their factories. They are looking far ahead, and their control is spreading accordingly. Indications are that there is a complete understanding between these companies and corporations, which is only to be expected. They do not encroach on each other's zone, and that eliminates high competition for land. As they continue extending their zones, and spheres of influence, they will gradually lessen, and probably eliminate, the competition for cane grown on independent lands.

At the present time competition for cane in many districts is such that high prices are obtainable by the cane farmer, and his end of the industry is a very profitable one; so much so, in some instances, that it is the farmer who gets the profit and the factory just makes expenses. But this expansion by big companies and corporations, controlling great areas of land, and respecting each other's spheres of influence, will undoubtedly do away with competition within those areas, and the price paid for cane will come down to a lower level. One does not pretend to forecast what that price will be; but it is safe to say that it will be just what those companies consider a fair price and no more. With an area controlled, and a full supply of cane obtained at a fair price, the operating of the factories will be a profitable business, even if prices of sugar are low. Moreover, if those corporations can become big enough, they should also have a stabilizing effect on the market.

We now see that the aim of those powerful companies is to own or control enough land to grow a full supply of cane for their factories, and at a certain price, thereby assuring a profitable business and good returns on the money invested. In addition, having large banks behind them, and refineries in league with them, they will control and handle the sugar from the canefield to the grocer. Obviously such a policy has big advantages, which should include:—

a. Lower cost of cane, bringing about a lower cost of production.

b. Elimination of intermediate parties, such as brokers, middlemen, etc., thereby reducing costs.

c. Lower cost of sugar delivered to the grocer.

d. If the Law of Supply and Demand did not interfere, one could add—"Lower cost to the public."

The above are the main advantages that can be expected from the trend of the industry in Cuba. There is one point however, that must not be overlooked while those developments are taking place, and that is the effect it will have on the farmer in those controlled areas. Up till now the independent farmer has received a high price for his cane, as the competition between factories has always been keen and the demand good. With competition eliminated, the farmer is going to receive much less for his output. He will not take kindly to that, and probably will consider other ways of making the most out of his land.

Take a farmer who is growing 12,500 short tons of cane, and getting 7·5 per cent. of sugar on weight of cane, or its equivalent, he will receive 937·5 tons sugar, or its equivalent. When his district is completely controlled and competition eliminated he will be paid say 6 per cent. for his cane, and so receive 750 tons sugar, or its equivalent, or 187·5 tons less. Delivering 12,500 tons cane, the reduction in his income will be, when sugar sells at 2·5 cents in warehouse at seaport, Cuba, 187·5 × $50·00 = $9375·00.

It will certainly make any farmer consider the situation he is placed in by the changing conditions described above, when he stands to lose not less than $9375·00 yearly. It is true, the amount of cane he grows does not warrant him

erecting a small sugar factory for himself, but he and two or three others may grow enough cane to justify a small co-operative factory between them. Let us assume that three or four farmers grow together three times the above-mentioned amount of cane, then we have a crop of 37,500 short tons. At the reduced price above referred to, those farmers stand to lose $28,125·00 between them yearly.

They will argue that if the large factory makes big profits when paying 6 per cent. for its cane, so can they, therefore they should sell their cane to themselves and not to the large company. However true or the reverse the above argument may be, we need not go into details, nor need we dispute it, although we know that the large factory will make bigger profits than a small one. The point is, the farmers are faced with a loss of $28,125·00 yearly, and they mean to prevent it if they can. Now a factory to grind their output of canes will be one dealing with from 13 to 14 tons per hour. Such a factory may cost erected anything from $220,000·00 to $250,000·00, a capital outlay that would be covered in from eight to nine years; this appears to be a conclusion that would attract any farmer.

Hence the question arises: Will those big Corporations and Companies force down the price of cane so far that the small farmers will be obliged to combine to protect themselves by erecting on their own lands small factories of just sufficient capacity to grind their own canes? No doubt the large companies are looking at this side of the subject, but so are the farmers, and the point is, how far will the big companies go with the lowering of prices on cane? On that depends whether or not they will be instrumental in bringing about the erection of a number of small factories in Cuba.

The foregoing is the trend of the sugar industry as we see it to-day. Good prices will stimulate that trend, and low prices will cause it to go slow, but notwithstanding that, the trend continues.

The first sugar cane forecast for the British India 1923-24 season, issued by the Commercial Intelligence Department, Calcutta, estimates the total area planted with sugar cane at 2,715,000 acres, as against 2,392,000 acres estimated at the corresponding date (August) last year. Weather conditions at the time of planting were generally favourable and the present condition of the crop is, on the whole, good: but much depends on the future course of the monsoon.

It is announced that the Honolulu Iron Works Company has purchased the well-known engineering business of Catton, Neill & Co. of Honolulu and New York, a firm that has been in existence since 1898. Both firms have of late years been very active in the Philippines, and it is doubtless in order to consolidate interests there and reduce costs that the amalgamation has taken place. The price paid the shareholders of Catton, Neill & Co. is said to be about one million dollars.

Opinions clearly differ as to the outlook for trade revival in this country. The President of the Board of Trade has expressed the opinion that no real revival is to be expected just yet A prominent business man, Sir Joseph Davies, in the *Daily Mail*, controverts this view and thinks that the turning point has arrived. One of his dicta is that the process of deflation has touched bottom, and the company or merchant who places orders to-day will do so on the best terms likely for some years to come.

According to consular advices, the exports from Formosa during the first three months of 1923 have shown expansion, mainly with respect to sugar, which rose over 18 million yen as compared with the same months in 1922. This represents an increase of nearly 50 per cent. in value and of over 30 per cent. in quantity, and indicates the stimulus received by the Formosan sugar industry by the rise in sugar prices. The latest news of the 1923-24 crop is that it will attain to 6,185,529 piculs, equivalent to 365,256 tons. The area under cane is now returned at 287,122 acres. In the event of this estimate being realized, the coming season will be second only to the record year of 1907, when the total production amounted to 7,634,903 piculs (450,841 tons).[1]

[1] For an earlier estimate see *I.S.J.* 1923, 419.

Root Disease of the Cane in Barbados.

Opinion in the West Indies appears to be settling down to the fact that "root disease" is at present the most serious one in the cane fields. Workers have of recent years devoted increasing attention to it, and quite a respectable literature is accumulating on the subject. While somewhat vaguely appreciated for a considerable number of years in the last century, it was not found easy to point out any definite cause of the disease; and it was not until 1895 that WAKKER in Java, noting the frequent occurrence of a small mushroom in the cane fields and especially where root disease was prevalent, named this organism which he described as *Marasmius sacchari* as the main causative agent. In this he was soon followed by HOWARD in Barbados, but in neither case apparently was the well-known mycological rule followed of bringing about the disease by inoculating healthy plants with the fungus. This was specially unfortunate in that the class to which Marasmius belongs would not be usually looked to for a dangerous parasite, being mostly composed of saprophytic forms only attacking dead or moribund plant tissues. Although, then, there has always been a certain amount of hesitation in accepting this diagnosis and etiology of root disease, the Marasmius theory has held the field in default of a better explanation until quite recently. Meantime, in other countries, quite a number of alternative organisms have been suggested, especially in the last few years, and it is now generally accepted that the term has been made to include various distinct phases of unhealthiness, from general unsuitability of environment to the attacks of definite parasites. Root disease has all along been recognized as connected with soil deficiencies, making themselves evident not only in the cane roots, but in the organs above ground dependent upon them; the roots are found dying in great numbers, the leaves become sickly and yellow, and the growth of the shoot is inhibited; in severer cases, besides stunting of the shoots, the apices are affected and decay sets in there, lateral shoots are thrown out and aerial roots appear, but these appearances are not so often met with, for the simple reason that the crop is rooted out as unsatisfactory as soon as the stunting effect is seen. One point more may be mentioned, namely, that it is chiefly in ratoon crops that root disease appears, the freshly planted canes apparently having sufficient vigour to carry them on until harvest time; but the absence of healthy ratoon crops is a matter of serious economic importance.

In a striking essay on the subject of "root disease" in Porto Rico, F.S.EARLE[1] analysed the literature up to date and strongly emphasized the idea that a whole series of separate ailments have been included under the term; and he completely discarded the parasitic nature of Marasmius. He maintained that the great bulk of these ailments are brought about by inadequate or wrong cultivation, thus depriving the plants of vigour and rendering them liable to the attacks of a number of hostile organisms which, unable to invade strongly growing canes with any success, can fasten on them as soon as they become enfeebled, from whatever cause. And, as in many other cases, here also the onslaughts of boring or gnawing insects or the attacks of parasitic fungi open the way for an invasion of a large number of semi-parasitic forms, so that the greatest diversity is met with in the root disease in different countries. This point of view has also been taken up in Hawaii[2] and Java. The actual parasitic fungi on the roots are apparently few in number. CARPENTER[3] in Hawaii points to Pythium, a well-known root destroyer; and in certain tracts PEMBERTON[3] has marked down a minute and extremely active centipede as gnawing the root tips so as to assist in the mycelial invasion. MATZ in a systematic study of the Rhizoctonias found

[1] *I.S.J.*, 1920, p. 675. [2] *I.S.J.*, 1923, p. 124. [3] *I.S.J.*, 1922, p. 87.

on crops in Porto Rico mentions three species as attacking cane roots. The same author has recently made a special study of "dry top rot" of the cane in Porto Rico (reviewed under *Recent Work in Cane Agriculture* in this number of the Journal). He ascribes this disease, which agrees in general with a severe phase of root disease, to an organism of Plasmodiophora type which, by plugging up the vessels of the fibrovascular bundles, cuts off the water supply. In Barbados a careful study has just been completed by BOURNE[1] of the relations between the soil fungi and root disease in that island. A still more recent paper has just been issued by KUYPER[2] in Java on root disease, in connexion with the rapid spread of a fine new seedling, EK 28, which is apparently specially liable to it. It is interesting to note that, in both Barbados and Java, the Marasmius theory is now definitely controverted as having no foundation in fact. KUYPER broadly states that the whole trouble is one of wrong cultivation, and finds no hostile organism; but BOURNE, on the other hand, has conclusively proved that the local root disease in Barbados is in the main due to two of the Rhizoctonias described by MATZ as occurring on the roots of sugar cane in Porto Rico. As most of the other papers have been recently referred to in this Journal, a somewhat detailed reference is here made to Bourne's important contribution to the literature on this widespread and complicated disease of the cane fields.

In introducing the subject, the author refers to the great losses incurred year by year owing to root disease in Barbados; and points out that the very diversity of opinion as to its cause makes it impossible to lay down any definite course of action towards eradicating or even controlling it in the infested areas. For a general historical résumé he defers in the main to that presented by EARLE mentioned above, but deals with the subsequent work in Hawaii and Porto Rico, and draws attention to an important paper by PELTIER on parasitic Rhizoctonias in America.

In discussing the symptoms, he finds it necessary to impose certain limits on the enquiry and, in consequence, accepts the definition given by MATZ of "true root disease in the canes," namely, "a decomposition of roots taking place on account of the invasion of fungi." This limitation must be borne in mind when the author records the severe epidemics of root disease in 1904, 1910, and 1916-7, when presumably the term had a wider application than the one he adopts. In 1920-21 BOURNE himself drew attention to great economic losses from this disease, and therefore devoted himself to a careful scientific study of the whole question, and proceeded to isolate by appropriate methods the organisms found in the roots of affected plants obtained from various parts of the island. The primary symptoms recorded do not differ from those given by other workers—decomposition and lack of healthy roots, stunted appearance of the cane shoots, unhealthy, yellowish green colour of the leaves often drying up in advanced stages. Top rot may also occur in advanced stages, and shrivelling of the leaves on hot days may indicate the inability of the roots to meet the demands of the plant for water; the relative growth and size of young plants is also treated as significant.

Isolation of fungi from the roots.—The following are quoted as typical cases. (1) Certain fields of first ratoons of BH 10 (12) and Ba 6082 in the parish of St. John. *Rhizoctonia solani* was obtained in pure culture from the roots of deceased plants of both varieties of cane in several instances. Fructifications of Marasmius were rarely met with in these fields, and this fungus was in no case

[1] Researches on the Root Disease of Sugar Cane. B. A. BOURNE. *Department of Agriculture, Barbados. Forwarded for publication in August, 1922.* [2] *I.S.J.*, 1923, p. 422.

isolated from dying roots. In one field *Rhizoctonia palida* was isolated from the roots, and no other Rhizoctonia was met with in it. (2) A field of fourth ratoons of White Transparent in the parish of St. Joseph. This field showed all the symptoms of root disease, "the pronounced yellowing of the leaves throughout the field coupled with the stunted appearance of the stools presenting a picture not easily to be forgotten." Numerous isolation trials resulted in several recoveries of *Rhizoctonia solani*, and the same results were obtained on repetition a few weeks later. In some cases a species of Fusarium was obtained from diseased roots, and is here recorded as the author is not aware of its having been noted elsewhere. In practically every case where *dead* roots were plated *Trichoderma lignorum* or *Marasmius sacchari* or both together were obtained in pure culture, but never from freshly diseased roots. Very often the internal tissue of the basal portion of the stem was seen to be of a dirty reddish colour, although there was no indication of any insect attack, and this was usually the case in advanced stages of the disease. Isolation trials showed either *Rhizoctonia solani* or *Rh. palida*, and in some cases one or other of the other three fungi mentioned, either singly or together. While examining the basal portion of a root-diseased stool, the author noted the typical reddening of the fibrovascular bundles described by MATZ and caused by the orange or brown cysts mentioned by that author as occurring in the wood vessels. He also found that these strongly coloured cysts failed to germinate, but here his agreement ceases. BOURNE states that the young "living cysts, on germination, break up into four actively motile ciliate protozoa within the thick walls which eventually become ruptured and liberate the motile organisms." He therefore disagrees entirely with Matz's placing these organisms among the Plasmodiophorales and regards them as Protozoa.

Etiology of the disease.—Having dealt with the isolation of fungi from the dead and dying roots of typically affected cane plants, the author now passes to a description of his experiments and observations on the effect produced by the various fungi mentioned when inoculated into healthy plants. The first series of experiments deals with laboratory treatment of roots, and the second with plants grown up to first ratoons in the open.

(1) Cuttings of healthy plants of Ba 6032 consisting of two nodes and one internode were sterilized and planted in sterile soil, one cutting in each of a series of large petri dishes. Pure cultures of the fungi were placed in contact with the root eyes and the cuttings then covered with soil. The necessary moisture was supplied by sterile distilled water and the whole series of dishes were placed in the sunlight each day. *Rhizoctonia solani*: Eight cuttings were dealt with, of which six were treated as above while in two the application of the pure culture was omitted. After six days all had germinated and were examined. In all the inoculated cuttings the roots were observed to be reddish and diseased looking and in sections under the microscope hyphae were seen to be present in the tissues; the untreated two showed no such appearances and were quite normal and healthy. Portions of the roots of all were plated out with the result that, in five out of six from inoculated cuttings, *Rhizoctonia solani* was recovered in pure culture, while no result was obtained from the untreated cuttings although kept under observation for a month. *Rhizoctonia palida*: Identical results were obtained with this fungus treated in the same way, with the solitary difference that only two cuttings were treated with pure cultures while two were used as controls. In Fusarium and Marasmius similarly treated, no effect was observable on the roots and no pure cultures were recovered on plating them out.

(2) Similar cuttings of healthy Ba 6032 were planted in five-gallon tins filled with typical black soil of good texture, with due arrangements for drainage, two of the cuttings being inoculated with pure cultures of *Rhizoctonia solani* and two not. The tins were placed outside, and kept moist with tap water, and the growing plants were photographed at intervals. Up to 56 days no differences were noticeable, but after that time a gradual yellowing of the leaves commenced in the two inoculated tins. At six months this yellowing was very pronounced, but there was no other difference in the shoots or the growth of the plants in the four tins. All of the shoots were then cut off. Three weeks later the rate of growth was seen to be distinctly in favour of the two controls, and at the end of two months the two inoculated plants showed distinct signs of root disease; their leaves were yellow and the shoots were stunted, as compared with the healthy green and normal growth of the controls. Ample proof was thus obtained of the ability of *Rhizoctonia solani* to reproduce the symptoms of root disease.

In identical experiments with *Rhizoctonia palida* similar results were obtained although the action of the fungus was not perhaps quite so rapid. At 65 days the plants were photographed and no apparent difference existed between the inoculated and control plants. At six months however a very pronounced yellowing was observed in the former, but no other difference. All the shoots were then cut off and the plants were grown on as before. After three weeks the rate of growing was distinctly in favour of the control, and two months later the inoculated plants showed distinct evidences of being affected by root disease, both in the yellowing of the leaves and the stunting of the shoots. Further examinations of the root systems in the case of plants inoculated with both of these fungi showed a smaller development in the inoculated plants, but a much more marked difference in the character of the individual roots; those of the latter being mostly black and dead and very few young white roots being present, whereas in the untreated controls numerous young vigorous white roots were present.

Although it is not claimed that a complete survey has been made of Barbados cane fields, there is every indication that one or other of these two Rhizoctonias may be found throughout the island. PELTIER observed that Rhizoctonia was universal in the soil, and that it can live indefinitely on organic matter, thus making it a dangerous parasite. MATZ observed *Rhizoctonia palida* on the roots of corn and pepper and *Rh. solani* on a greater number of plants other than sugar cane. PELTIER in the United States enumerates 165 plants subject to attacks by the latter fungus, thus demonstrating that there is no marked specialization of hosts which may harbour it. BOURNE considers it probable that the same may be true with regard to *Rh. palida*. Furthermore, these fungi are able to pass long periods in the sclerotial form, for PELTIER kept cultures of *Rhizoctonia solani* dried for three years in his laboratory and after this obtained pure cultures of it. He concluded that a high degree of temperature (88°F.) and deficiency of soil moisture were favourable: such a degree of heat was observed to be exceeded in the tin experiments three inches below the surface of the soil. And one of the main facts, noted by BOURNE in his investigations, was that in all the cases where root disease was evident the plants were ratoons, and that these were growing on land without the usual covering of trash which is present in young plant canes. Such conditions would obviously favour high temperatures and dried out soil.

The advantage of the occasional throwing out of cane, which is the practice in Barbados fields, is however undoubtedly of value in decreasing the virulence of the root fungi, and but for it the author surmises that much more serious epidemics

would probably occur. For the summary of results and the recommendations offered in this paper the reader is referred to page 541 of this number, where the subject is more briefly treated. Details of the preparation of media and the growth of the different fungi in them are appended together with a number of photographs of the canes grown in the various experiments referred to above. A description of the protozoon found in the vessels is also given, and the paper concludes with a selection of important papers on root disease consulted by the author.

C. A. B.

The Beet Sugar Industry and Sugar Beet Culture of the United States.

Present Development and Future Possibilities.

By OSWALD WILSON,
Editor "Sugar Beet Journal," San Francisco, California.

The American beet sugar industry embraces the manufacturing and marketing of beet sugar, while sugar beet culture is the agricultural effort for the production and delivery of the beets to the factory. They are closely related and interdependent. Combined, they constitute the greatest and most successful co-operative business enterprise in the United States. With an aggregate invested capital of more than one billion dollars, in factories, farms and equipment; with an annual output of $250,000,000; giving employment to more than 100,000 wage earners; furnishing 8,000,000 tons of freight to the railroads and an expenditure of $50,000,000 annually for steel and machinery, concrete and lumber, coal, fuel, bags and other supplies for the maintenance and operation of the factories, and for tractors, ploughs, seed and other implements for the maintenance and operation of the farms, domestic beet sugar ranks as one of the leading industries of the country.

The production and marketing of beet sugar is the important factor in the agricultural, industrial, and commercial life of each district where it is maintained. In several States it is the chief source of income, exceeding all other activities. In Utah and Idaho sugar excels all other industries except copper, and the same is true in Colorado.

But very few persons, even among those directly connected with the industry, realize the value and importance of our domestic beet sugar and that it is in its infancy. The next 20 years will place the sugar beet and its products in the front rank and at the head of all industrial and agricultural enterprises in the United States, as farmers, labour, and capital have just awakened to its value and possibilities.

The beet sugar industry of the United States.—The present development of the beet sugar industry in the United States dates from the establishment of the first factory, 53 years ago, at Alvarado, California, 20 miles across the bay south of San Francisco; this factory is in successful operation to-day, under the efficient management of Mr. R. S. STEWART. The next factory was established, ten years later, at Grand Island, Nebraska, by the Oxnards. During the next 20 years there were only 14 factories built: one in Wisconsin, one in Colorado, two in Utah, five in California, and five in Michigan.

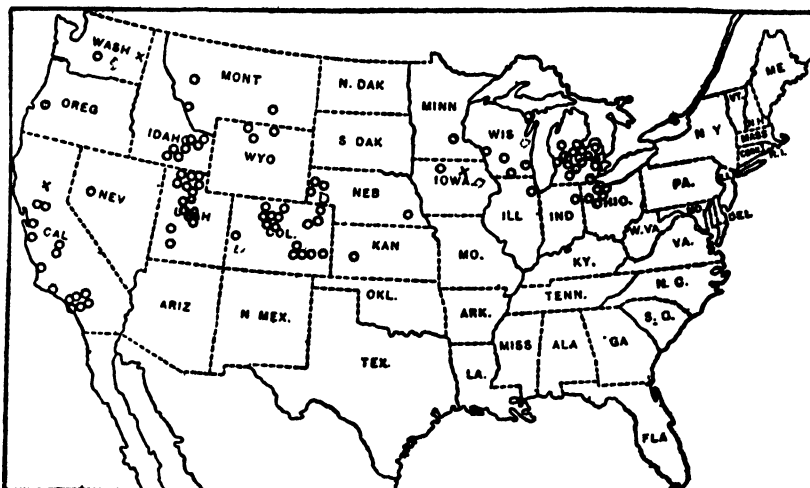
Up to 1900 there were only 16 factories, but from that time to 1920 there was a very rapid expansion of the industry extending from the Pacific Ocean east

to Ohio, resulting in the building of 90 new factories, making an aggregate of 106, the present number.

California, besides being the pioneer State, has the largest beet sugar factory in the world, at Spreckles, California, having a daily slicing capacity of 4500 tons of beets, while the factory at Oxnard slices 3000 tons of beets every 24 hours.

Invested capital and capacity.—That the reader may gather some idea of the magnitude and importance of the U.S. beet sugar industry, the following statements are taken from the U.S. Census Report of 1919, but do not include any investments or expenses paid by the farmers in growing the beets:—

Capital invested	$224,584,679
Primary horse-power	127,394
Daily slicing capacity	—
Tons of beet	107,150
Annual capacity, tons of sugar	1,607,250
Employees	14,190
Wages paid	$20,336,074
Taxes and rents	$11,450,000
Paid farmers for beets	$87,029,144
Value of sugar and by-products	$149,155,892



The Extent of the American Beet Sugar Industry.
O = Mills in Operation. X = Mills idle.

It is interesting to know that the domestic beet sugar industry has more invested capital, utilizes more horse-power, pays more taxes, and adds more value by manufacturing than all the refineries of cane sugar in the United States. although the cane people handle five times more sugar than the beet people. At the same time, even under this handicap, beet sugar is manufactured and marketed for 20 cents per bag less than the cane sugar; in other words, the consumers in the United States are paying $18,000,000 every year more for cane sugar, because we have not fully developed our domestic sugar beet fields.

By-products.—In addition to the sugar, the pulp and molasses are very valuable by-products. The pulp is used in feeding dairy cows and for fattening cattle and sheep for market; and these animals make a greater profit and command

a better price than those not so fed. But there is a more important and valuable outlet for the beet molasses than for feeding, namely, for producing yeast to make bread, and also in road-building and for orchard sprays, grasshopper poisons, and many other beneficial uses. One manufacturer of yeast could do with 250,000 tons annually.

The sugar beet culture.—The sugar beet is established and successfully grown in 19 States, in 17 of which factories are located, and arrangements are being made for additional factories in the other States. Sugar beets are the most profitable and beneficial crop grown by the American farmer. "Sugar beets stand at the head of all the crops of the temperate zone in the amount of energy that can be produced in a given area. They are the most efficient of all machines for the fixation of solar energy in a form so that it can be used in the human body to produce muscular power. An acre of sugar beets may produce nine million calories of energy, more than twice as much as potatoes; three times as much as barley or oats, and more than four times as much as wheat or rye."

The farmers have received in cash $321,211,000 for beets grown during the last five years, 1918–22 inclusive, an average of $91·70 per acre. This far exceeds the returns per acre from all other crops, even on the irrigated lands. The average return from the 10 principal crops in the United States is only $18·20 per acre, which includes wheat, corn, all cereals, cotton and tobacco. Seventy-five per cent. of the sugar beets are grown under irrigation and at the low price of $6·30 per ton; in 1922, sugar beets returned $84·32 per acre, while the average return for all other crops on the Nebraska irrigated project of the United States Reclamation Service was only $12·74 per acre. In addition to the cash received, the farmers had the value of the tops for feeding, and the indirect benefit to the soil by sugar beet culture increasing the yield of succeeding crops under rotation.

Quality of the beets.—The quality of the American beets is equal to the best in Europe, and is improving as our farmers become more accustomed to and adopt the best cultural methods. The United States Government reports for 1922 give the average sugar in a ton of sugar beets as follows :—

	Average per cent. Sugar.	Average per cent Purity.	Average Extraction.
United States	15·84	83·76	272·2 pounds of sugar.
California	18·48	87·71	345·6 " "

With selected seed, deep tillage, and improved cultural methods, California will produce more sugar than any other country. A number of districts now average 5199 lbs. of sugar per acre, and could produce 6932 lbs. if the proper effort was expended.

In fact, one-third of the cultivated lands in California alone could produce as much beet sugar as the whole of Europe did prior to the war, and the aggregate in these States in land, labour, capital and equipment is greater than all of Europe to-day.

Labour required.—Sugar beet culture is not as hard or laborious as some other crops, and pays a greater return for the labour expended than any other farm operation. It requires an average of 120 hours of man labour and 112 hours of horse labour to prepare, cultivate, harvest and deliver an acre of beets, which is less than cotton, vegetables and some other crops. The majority of our farmers contract the "hand labour," that is the thinning and blocking, second and third hoeing, to Mexican and other labourers supplied by the Sugar Companies. The price of contract labour this year averages $21 per acre.

THE CONSUMPTION OF SUGAR.

The United States is practically consuming 30 per cent. of all the sugar produced in the world, and the *per capita* consumption is steadily increasing.

Of the total consumption, practically 40 per cent. comes from the domestic beet and cane from Louisiana and our island possessions, and the balance (60 per cent.) from foreign countries.

The details of consumption are shown in the following table:—

Year.	Lbs.	Domestic Cane and Beet. Per cent.	Island Possessions. Per cent.	Foreign Cane. Per cent.	World Production. Per cent.
1865	18·17	1·9	11·1	87·0	14·3
1870	32·73	7·0	16·2	76·8	23·3
1875	43·33	7·5	13·2	79·3	29·0
1880	39·46	9·2	14·1	76 7	27·1
1885	47·87	8·5	18 9	72·6	24·5
1890	50·72	9·6	17·6	72·8	25·0
1895	62·69	17·9	9·2	72·9	24·3
1900	58·91	10·9	14·0	75·1	23·1
1905	71·66	21·0	19·6	59·4	28·3
1910	79·90	19·0	25·2	55·8	22·0
1915	83·83	22·7	21·3	56·0	24·0
1922	102·00	17·1	15·9	67·0	30·0
1923*	54·00	15·5	25·1	59·4	—

* Six months.

Canada.

Production of Sugar Beets and of Beetroot Sugar, 1922.[1]

The following table gives particulars respecting the area, yield, and value of sugar beets grown for beetroot sugar and the production of refined sugar made from Canadian-grown sugar beets, for the year 1922, with comparative figures for the years 1911 to 1921. During 1922 only two Canadian beetroot sugar factories were in operation, viz., those at Chatham and Wallaceburg, Ontario.

Year.	Acres grown.	Yield per acre. Tons.	Total yield Tons.	Average price per ton. $	Total value. $	Production of refined beetroot sugar. lb.
1911	20,677	8·50	175,000	6·59	1,154,000	21,329,689
1912	18,900	10·50	201,000	5·00	1,005,000	26,767,287
1913	17,000	8·75	148,000	6·12	906,000	26,149,216
1914	12,100	9·00	108,600	6·00	651,000	31,314,763
1915	18,000	7·75	141,000	5·50	775,500	39,515,802
1916	15,000	4·75	71,000	6·20	440,000	17,024,377
1917	14,000	8·40	117,600	6·75	793,800	23,376,850
1918	18,000	11·25	204,000	12·71	2,593,715	50,092,835
1919	18,800	9·50	180,000	14·61	2,630,027	37,839,271
1920	34,491	9·94	343,000	15·47	5,307,243	89,280,719
1921	25,535	7·80	199,334	9·90	1,974,384	52,862,377
1922	14,955	8·55	127,807	7·56	966,521	29,911,770

The total value of the beetroot sugar produced is estimated at $1,645,885, representing an average wholesale price of 5½ cents per lb. For 1921 the corresponding values were $3,554,203 for total value and 6·7 cents, the average wholesale price per lb.

[1] From *Monthly Bulletin of Agricultural Statistics*, Dominion Bureau of Statistics, Ottawa, Vol. XVI, no. 179.

The Australian Sugar Industry.

Getting Back to Normal.

By T. D. CHATAWAY.

It has taken some months to arrive at even a partial settlement of the relations between the Australian cane sugar industry and the Commonwealth Government. It is eight years ago since the industry was first placed under control, its product commandeered, and the export, if export were possible, prohibited. As the result of the last general elections it was considered that the people of Australia had decided that there should be no further agreement between the Commonwealth and the sugar producers. The new Government, which came into existence last February, was urged to make a statement as to its intentions, especially in view of the fact that planting would take place, in ordinary circumstances, in the latter end of March, April and May. In March the new Prime Minister, Mr. BRUCE, said definitely that the Government did not propose to renew the agreement but that it was prepared to recognize the importance of the industry and give it every protection against unfair competition, which of course was accepted as meaning such competition as a "White Australia" industry might expect from other sugar industries carried on with relatively cheap coloured labour. Meanwhile the sugar producers and mill-owners clamoured for something more definite, and eventually the following compromise has been reached. There is to be a new agreement. The Commonwealth will place an embargo upon the importation of foreign sugar for the next two years, and the Queensland producers (who constitute 90 per cent. of the whole of the sugar producers of Australia) are to form a pool, take over the Commonwealth's surplus stocks amounting to about 57,000 tons at June 30th, 1923, and agree for the current year to sell raw sugars to the refiners for £27 a ton at the mills, which means £3 6s. 8d. less than the price during the three years' agreement.

REFINERS FORCE POSITION.

The Government practically told the producers that they could accept this offer, or go without it, and there is no question that the position would have been awkward if the Commonwealth had started unloading its surplus in competition with the new crop which was then expected to commence coming in about the middle of this month. The Australian Sugar Producers' Association, which speaks more authoritatively for the industry than any other body, objected that the agreement meant very little more than that there was to be a reduction in the price of the farmers' cane, and an embargo upon imports which, from the appearance of the world's statistical position, was quite likely to prove of no practical value. Throughout Queensland a storm of protest was raised except in what are politically called Labour circles. In the latter it was argued that the Government proposal was far less than required, but that some continuance of Government control was necessary in order to protect the mills and the farmers from falling again under the control of the refiners. In November last the shareholders of the Colonial Sugar Refining Company had been thus addressed by their general manager :—

"We have, as you know, been working the refineries for the Government during the past seven years, and are prepared to continue to do this. or to resume the management of our own business, being fully equipped, financially and otherwise, for the adoption of either course."

There is little question that in the face of this the sugar producers thought that the refiners were ready and willing to resume the pre-war position, when they paid a fixed price for raw sugar on the spot, and a further bonus at the end of the year based upon the price obtained for the refined sugar. For that reason the producers were not at all inclined to continue under any form of Government control as to price. It seemed to them that they were getting a reduced fixed price on what looked like a rising market, and that the old system would suit them better. It was the raw sugar industry therefore that did not want a renewal of the agreement, even in the modified form proposed. At the last moment there came the following rather staggering telegraphed announcement by the refiners, regarding the short embargo and their arguments for acceptance of the Government's offer :—

"If embargo not continued, we unable accept responsibility for financing crop, because if market breaks this probably happen November when European beet crop, which considerably larger than 1922 comes in, or few weeks later when Cuba crop begins. Meantime all Queensland crops would be handled. Position about this would be serious if Java or Mauritius whites could be bought cheaply towards end of year for preserving and brewing, and refineries had been occupied till September on Federal surplus, and only conclusion we can now come to is that present offer should be accepted. Had we thought possible embargo would be denied or refused, we would never have offered on basis of £24 at our mills, and we doubt now whether paying £21 for 150,000 outside our own production would be safe for all expenses, transport and refining greatly in excess pre-war figures."

This refusal to finance the crop, at the very moment when the crushing season was commencing, had the effect of silencing the objectors to the Prime Minister's proposals, and placing the industry largely under the control of the State government which, under a war measure that has remained unrepealed, has still the power to commandeer the whole sugar crop. Being a Labour government, and having itself a direct interest through some of the central mills in the industry, this opportunity to increase its hold over the industry was too good to be missed.

FORMATION OF THE POOL.

No time was lost by the Queensland Government, once the opposition of the producers had ceased. It issued a proclamation appointing a Sugar Board, consisting of representatives of the Australian Sugar Producers' Association, the United Canegrowers Association, and the Government, and endowed the Board with the following duties :—

"Subject to the direction and approval of the Treasurer, such Board shall make all investigations, negotiations, and recommendations regarding :

(a) The delivery of such raw sugar by the manufacturer thereof and the payment for the same of the proclaimed price, and the refining, treatment, preparation, manufacture, sale, and disposal of such raw sugar ; and

(b) The purchase, acquisition, or dealing by the Treasurer, on behalf of the Government of Queensland, of or with—

   (i) Any sugar the property of the Commonwealth of Australia at any time not later than the thirtieth day of June, 1924 ; and

   (ii) Any sugar produced in the State of New South Wales not later than the thirtieth day of June, 1924 ;

and the delivery thereof and payment of the agreed price thereof or the terms and conditions of the acquisition thereof or dealing therewith, and the refining, treatment, preparation, manufacture, sale, and disposal thereof."

As the sugar industry of New South Wales is the property of the Colonial Sugar Refining Company, it comes naturally into the pool recommended by the Company itself.

POLICY OF THE POOL.

The Queensland and New South Wales pool has been formed, has taken over the Commonwealth surplus, and fixed the price of raw sugar for 1923 at £27. The refiners will not resume their old position as the financiers of the industry and the pool will doubtless make arrangements with the banks to take over the work. There have been changes in the control of the refining business, and it appears that pessimism has taken the place of the healthy, though guarded, optimism of the past. The pool is already preparing to strengthen its position as against the refiners. It has been decided to cut out the merchant middleman as far as possible. The refiners will have to sell direct to the retailers, and obviously they cannot do so unless they have the sugar to sell, and they cannot have the sugar (while the embargo lasts) unless they buy the product now in the hands of the pool. The new position is on the whole, I think, more satisfactory to the producers than to the refiners. It is likely to lead in a year or two to the reduction of the refiners to the mere position of agents, much as they have been in some cases in Louisiana, where they receive the raw sugar and refine it at a fixed charge and sell on commission. This promises to be yet another improvement in the general sugar position, and will lend itself in the future to the production of a certain amount of low grade sugar by the mills themselves, which will go into consumption under the aegis of the pool (which I expect has come to stay), and will not go through the hands of the refiners at all.

PRICES AND REBATES.

As to the price to be paid for raws in 1924 it has been decided that it will be fixed by a tribunal, which will probably consist of two representatives of the two organized branches of the sugar industry, and two others representing the consumers and the Commonwealth Government. These four will appoint their own chairman who may be a supreme court judge, though what such an official would know either about the industry or the trade is by no means clear. However, there is little reason to suppose that unless world's prices fall enormously within the next nine months the price of raw sugar next year will be seriously changed. Another tribunal is expected to fix the rebate to be granted to manufacturers of goods for export, and in this case the Queensland Government will have at least one representative out of three to look after the interests of the sugar industry. The Prime Minister has declared that at the end of this two years' agreement the industry will have to look after itself, but he has added an assurance that this does not necessarily mean that the protective duty will not be increased, even if it does not also mean that it will not be decreased. In brief, the chief facts are that the price of raw sugar has been reduced by £3 6s. 8d. a ton, which is precisely what the sugar people themselves suggested early in the year; there will be an embargo upon imports for two years; and meanwhile the creation of a pool is expected to make the industry more independent of the refining interests.

FURTHER PRODUCTION.

There seems little doubt that the attitude of the refiners was in part due to a desire to rid themselves of their self-assumed responsibility in pre-war days for financing the output; and partly to their objections to any further increase in production, as intimated by the decision of the Queensland Government to open up a new sugar area in what is known as the Tully district, lying between the Herbert and Johnstone rivers north of Townsville, and the erection of another large sugar mill with a capacity of at least 15,000 tons of raw sugar per annum, on

the same lines as the two successful mills at Babinda and South Johnston. These last two mills have paid their way from the start, despite the fact that they are practically under Government control, and the Tully prospects are no less bright. The moment the mill is assured farmers will flock to the area, and, before the erection of the mill is completed, will probably have sufficient cane ready for harvesting to keep the mill occupied up to its fullest capacity. There is a natural tendency on the part of those who live from hand to mouth to believe that Australia cannot afford to produce more sugar, though with immigrants pouring into the country, with the establishment of new manufactures by English capital, and the natural increase of population, it is not easy to understand the tendency. Further with the increasing capacity of the sugar mills, none under 10,000 tons being now considered economically safe, there must be a decrease in cost of manufacture. The figures given in my last communication and quoted from the Auditor-General's report are sufficient evidence. Obviously with reduced cost comes reduced price and increased consumption. Already wages rates in the mills and fields are slightly, but definitely, reduced—one penny per hour does not seem a great deal, but it is the turn of the tide. Yet it is not in reduced payment of labour, so much as in the reduction of the quantity of labour employed per unit of production that the industry hopes to hold its own.

Outlook for the Present Season.

The outlook for the present season has greatly improved. While the sugar districts about the centre of the Queensland coastal areas will give poor results, they will certainly yield more than was expected, and still further South the rain having come rather earlier the yield will be proportionately better. In the North, though the usual wet season has not given the regular quantity, the rainfall has been more evenly distributed, and in places even a record crop is foretold. The Queensland Superintendent of Sugar Experiment Stations, Mr. H. T. Easterby, has issued his latest forecast, and this estimates the current output in Queensland at 240,000 tons, with an additional 16,000 tons for the production of the three sugar mills in Northern New South Wales, and, say, 2000 tons for the one beet sugar factory in Victoria, making the total production for the 1923-24 season 258,000 tons. Adding this to the 57,000 tons in hand at July 1st, and assuming a consumption of 280,000 tons for the year, it is anticipated that at the end of next June there will be a carry over of 35,000 tons which is not greatly in excess of normal pre-war times. But this is putting consumption on the basis of the past year, when the domestic demand was restricted by high prices, 6d. and 5d. a lb., with the jam, fruit canning and other manufactures facing an overstocked market, as against a probable 4½d. per lb., and the recovery of the jam and canning business. It seems quite likely that the consumption will exceed 280,000 tons. Thus the market position to the end of next June appears to be a sound one, without particular reason for anxiety concerning the year ending June, 1925.

Prospects of Beet Sugar.

There is quite a novel anxiety on the part of the cane producers for the expansion of the sugar-beet industry. At present it exists only in Victoria, where there is one factory, which has led a solitary and precarious existence for the last twenty-five years, during some of which time it has stood idle, and at no time has produced more than 3000 tons of sugar. The building in which the machinery is housed is a large and imposing structure, built by a German firm and unnecessarily well suited to withstand heavy snowstorms and arctic cold. But if in a long season it can produce 3000 tons of sugar it has accomplished the most

that it is capable of. The cane sugar producers of Queensland frankly want the industry to expand, for the simple reason that they want the political assistance of Victoria in maintaining a protective duty against the importation of sugar. The Maffra (beet) factory has long since passed into the control of the State Government, and from time to time promises have been made to encourage the business, give the farmers irrigation, and in other ways stimulate the industry. The assumption has always been that the farmers will not grow beets. I am informed on the best authority that they will not grow beets because the capacity of the factory is insufficient to cope with any considerable supply. Mr. WILLIAMS, the manager, recently visited America, and on his return advised that the considerable sum of £100,000 should be expended in bringing the factory up-to-date, and increasing its capacity. This was asking much of the most careful State Treasurer Australia has ever known, so it was decided to get yet another expert to report, and at the present moment a Mr. GRAHAM from the United States is going over the much-trodden ground. It is believed that if his report follows that of Mr. WILLIAMS and makes similar recommendations, then the Victorian Government will find the money and the farmers, assisted by the irrigation works now laid down, will put the factory on a 10,000 ton basis in a very short time. Sugar beets have also been successfully grown on the South Australian side of the border between that State and Victoria, and the Maffra experiment only requires to be definitely successful when we shall doubtless see the rapid expansion of the industry. In Western Australia, especially, where the long freight from the eastern States makes sugar so expensive that agitation is always afoot to import sugar from Java, the sugar-beet industry should also gain a firm footing.

POSITION IN FIJI.

In Fiji, where there is practically no sugar production except that encouraged and controlled, more or less, by the Colonial Sugar Refining Company, a highly unsatisfactory situation has arisen. Originally the Australian Company conducted its Fiji operations as an adjunct to those in Australia, but more recently a new Company was formed from the parent corporation to carry on the business. It has generally been supposed that this was for the purpose of avoiding the excessive Commonwealth taxation, and for the moment the adventure seemed to have been successful. But the Fijian government imposed a duty of £1 a ton on exports, and propagandists of the Ghandi agitation succeeded in dislocating business. As a separate Company Fiji doubles the difficulties of the parent company. Mr. KNOX, the able general manager of the parent body, was summoned to London to discuss the position with the Imperial Government, and the Company finally reached agreement concerning the employment of Indian labour and the settlement of Indian farmers, after which the matter came under consideration by the new Indian government. The last reports from Fiji were that only one or two of the several mills of the Colonial Sugar Refining Company would be sufficiently supplied with cane to crush this year, and that the output, though greatly restricted, would be enough to supply New Zealand's requirements. Yet only a few weeks ago New Zealand was buying Java raw sugars in order to keep the refineries in the Dominion supplied. It is too soon to say that the industry has been destroyed, but there seems little question that had it remained as a branch of the Australian business, the Indian agitation would have created much the same position as at present.

The late SIR ROBERT PARK LYLE, Chairman of Messrs. Tate & Lyle, the sugar refiners, who died last July aged 63, left estate of the gross value of £700,628 with net personalty £641,353.

Sugar Factory Pumps.

By P. H. PARR.

Practically every type of pump on the market has been used at one time or another in some sugar factory, but those in general use, as the result of years of experience, are few in number. For all general purposes, the direct-acting steam-driven duplex pump is practically supreme; it is cheap, reliable, and flexible in working. Singlex pumps are also very popular for certain work. Ram—or plunger—type pumps, either steam or motor-driven, are used to a considerable extent, but they are much more expensive than are the piston-type pumps of equal capacity, and their use is comparatively restricted.

A number of the modern "Centrals" use motor-driven plunger-type pumps throughout the factory, but whilst such pumps may be suitable for a large central factory, where the working can be maintained practically uniform under the highly efficient control usual in such cases, they have no useful flexibility in working, and for sugar factories crushing less than say 1000 tons of cane per day, steam-driven units are far more satisfactory. Even in the largest factories, steam pumps are the best for dealing with the evaporator and the filter presses, as their speeds can readily be adjusted exactly so as to obtain the most efficient conditions of working.

For the evaporator, a few factories use a set of multiple-throw pumps, steam or motor-driven, for feed, calandria drains, and syrup extraction, but, although these combined sets may be a little cheaper than are independent pumps, they are not to be recommended; the speeds of such combined sets are necessarily determined, in working, by the requirements of the juice feed to the evaporator, and then the drain and syrup pumps will usually be found not to be in the exact proportions necessary to secure the best working, and either to fail in their duties through being too small, or else to "knock" through being too large.

The best arrangement for both the drain and the syrup extraction pump for an evaporator is to install a receiving reservoir, with a float gear connected to the steam valve of the pump, so as to adjust the pump speed exactly to the amount of liquor flowing. These pumps must have water-sealed glands.

All pumps for sugar factory purposes should be "brass-fitted," that is, there should be brass liners to the pump barrels, brass buckets and valves, muntz metal pump rods, etc., and for dealing with the calandria drain water, which is often slightly acid, pump bodies entirely of brass are the best. For scums and for syrup, ball valves are good, but the advantages are of minor importance; usually it is better to keep to the standard type, and to use as few types and sizes of pumps as possible, so as to reduce the spares to a minimum.

The singlex pump—one side of a duplex pump, but with a different valve gear—is of considerable value in many cases, and is almost as popular as the duplex pump. The horizontal type is often known as a "special" or "Cornish" pump. For boiler feeding this pump, of the vertical "Weir" pattern, is rapidly becoming the standard. The "Weir" pump was originally designed for marine purposes, in which sphere it quickly gained a high reputation for convenience and reliability, and it now occupies a very important position for land work.

The "Cameron" type of steam-driven single- or double-ram pump is favoured by a number of engineers: it is very good indeed and gives a minimum of trouble, but it is expensive, costing from three to four times as much as a duplex pump of the same capacity, and its use in sugar factories is comparatively limited.

Horizontal steam-driven flywheel-type pumps are occasionally used, chiefly in the smaller factories, but in general they are of minor importance.

Small belt-driven pumps are sometimes used and are convenient for odd purposes, but they are seldom seen except in small factories.

Where large quantities of a liquid have to be dealt with, as for the injection water supply to the condensers, the only pump is the centrifugal, which should be directly connected to either a short-stroke engine or an electric motor. In this connexion, it is very useful to note that the discharge in thousands of gallons per hour is roughly the square of the diameter in inches, so that, say, an 8 in. centrifugal pump is suitable for 64 thousand gallons per hour, or a little more.

In general, the most suitable pumps for a sugar factory appear to be, for all general purposes, the duplex; for evaporator drain and syrup extraction, the long-stroke singlex; for boiler feed, the vertical singlex of the "Weir" type; and for injection water, the centrifugal, direct-coupled to engine or motor.

A very important question for sugar engineers is as to the capacities of the various sizes of pumps for different work, and the capacities stated in the pump makers' catalogues are absolutely useless for sugar juices under ordinary factory conditions. Sugar engineers differ in their ideas as to pump capacity, but the accompanying tables give fair average net capacities for the various standard sizes of pumps when dealing with sugar factory liquids: perhaps they are slightly conservative, but they are (in round figures) on a uniform basis, and are in accordance with the best modern practice. Pumps selected from these tables may be relied upon to give satisfactory results in working.

The figures in the bodies of the tables are the nett English gallons per hour which the different pumps should readily deliver when working with the various liquids mentioned. The pump sizes are in inches, and read (steam cylinder dia.) × (pump dia.) × (stroke). For the singlex pump no cylinder diameter is mentioned, as almost any size may be fitted; if used for boiler feed (not recommended), the steam cylinder should be 1 or 2 in. larger than the pump; for general purposes, the steam cylinder may be the same size, or 1 to 2 in. smaller than the pump, according to the work.

As an example of pump selection, suppose we consider a sugar factory crushing 25 tons of cane per hour in an 11-roller mill, with 16 per cent. maceration on cane, and giving 200 gallons juice per ton cane; all duplex pumps. Assuming a quadruple effect evaporator, 75 per cent. evaporation, first calandria drained through steam trap, second through syphon, third and fourth by the same pump, and taking the boiler feed at 60 per cent. on the cane, then we may tabulate roughly as follows:—

	GALL. PER HOUR.	PUMP.
Maceration water	900	$5\frac{1}{2} \times 3\frac{1}{2} \times 5$
Return juice	900	$5\frac{1}{2} \times 3\frac{1}{2} \times 5$
Main juice	5000	$6 \times 6 \times 10$
Calandria drain	1875	$8 \times 6 \times 8$
Syrup extraction	1250	$8 \times 6 \times 8$
Boiler feed	3300	$8 \times 6 \times 8$

After an inspection of the above, the last four pumps would all be made 8 × 6 × 8, and the water service pump would be made the same. Next, taking scums, etc. at 20 per cent. of the juice, we have 1000 gall., or a pump 6 × 4 × 6, and we should make the maceration, return juice, scum, and filtered juice pumps (probably also the general washings, etc., pump) all this size, thus only having two sizes for nine or ten pumps. The difference in cost is negligible, and the practical advantages of minimizing the number of sizes of pumps is obvious,

whilst the flexibility of the steam pump is so great that the result is absolutely satisfactory in practice. On the contrary, with belt or motor-driven pumps, which usually do not admit of much speed variation, the pumps must be more carefully adjusted to the exact work they have to do, and they are not satisfactory if the factory has to run at a lower rate than designed. Of course electric motors can be slowed down, but no one wants to install a number of small motors of the

SINGLEX PUMPS.

Pump.	Water; Juice.	Boiler Feed; Scums.	Syrup.	Calandria Drains.	Syrup Extraction.
3 × 12	750	550	450	320	240
4 × 12	1350	1000	750	550	450
5 × 12	2100	1600	1200	900	650
6 × 12	3000	2300	1700	1300	950
7 × 12	4000	3100	2300	1750	1300
8 × 12	5500	4000	3000	2300	1700
9 × 12	7000	5000	3800	2900	2200
10 × 12	8500	6500	4500	3600	2700
11 × 12	10000	7500	5500	4500	3200
12 × 12	12000	9000	7000	5000	3800

DUPLEX PUMPS.

Pump.	Water. Juice.	Boiler Feed, Scums	Syrup.	Calandria Drains.	Syrup Extraction.
3 × 1½ × 3	150	110	85	65	50
3 × 1¾ × 3	210	160	120	90	65
3 × 2 × 3	270	200	150	110	85
3¼ × 2 × 4	300	230	170	130	100
4 × 2½ × 4	500	360	270	200	150
4½ × 2¾ × 4	600	450	320	250	190
4¾ × 3 × 5	800	600	450	320	250
5¼ × 3½ × 5	1100	800	600	450	340
4½ × 3¾ × 4	1100	—	600	450	340
6 × 4 × 6	1550	1200	900	650	500
5¼ × 4¾ × 5	2000	—	1100	850	650
6 × 4½ × 6	2000	1500	1100	850	650
6 × 4 × 10	2300	1700	1300	950	750
6 × 5 × 6	2500	1850	1400	1050	800
6 × 6 × 6	3500	—	2000	1500	1100
6 × 5 × 10	3600	2700	2000	1550	1150
8 × 5½ × 8	3600	2700	2000	1550	1150
8 × 6 × 8	4500	3200	2400	1850	1350
6 × 6 × 10	5000	—	2800	2200	1650
8 × 6 × 10	5000	3800	2800	2200	1650
6 × 7 × 8	6000	—	3400	2500	1850
8 × 7 × 10	7000	5500	4000	3000	2200
6 × 8 × 8	7500	—	4500	3200	2400
10 × 7½ × 10	8000	6000	4500	3400	2600
8 × 8 × 10	9000	—	5000	3800	2900
10 × 8 × 10	9000	7000	5000	3800	2900
7 × 9 × 8	9500	—	5500	4000	3000
8½ × 10 × 10	14500	—	8000	6000	4500
12 × 10 × 10	14500	10500	8000	6000	4500
8½ × 10¼ × 10	15000	—	8500	6500	5000
10 × 12 × 10	21000	—	11500	8500	6500
14 × 12 × 10	21000	15500	11500	8500	6500

"WEIR" BOILER FEED PUMPS.

Pump.		Capacity.	Pump.		Capacity.
3½ × 2½ × 5	....	200	8½ × 6 × 18	....	3500
4½ × 3 × 6	....	330	9½ × 7 × 21	....	5500
6 × 4 × 7	....	650	10½ × 8 × 22	....	7500
6 × 4 .. 12	....	1000	12 × 9 × 24	....	10000
7 × 5 × 12	....	1600	13½ × 10 × 24	....	12500
8½ × 6 × 13	....	2500			

"CAMERON" DOUBLE RAM PUMPS.

Pump.	Water; Juice.	Boiler Feed; Scums.	Syrup.	Calandria Drains.	Syrup Extraction.
4 × 2 × 3	135	100	75	55	45
5 × 2½ × 4	240	180	135	100	75
6 × 3 × 5	390	290	220	165	125
6 × 3½ × 5	550	400	300	230	170
7 × 4 × 6	800	600	450	330	250
7 × 4½ × 6	1000	750	550	400	310
7 × 5 × 6	1250	900	700	500	390
7 × 5 × 7	1350	1000	750	550	450
8½ × 6 × 6	1750	1350	1000	750	550
8½ × 6 × 8	2200	1600	1200	900	650
10 × 7 × 7	2700	2000	1500	1150	850
10 × 7 × 9	3200	2400	1800	1350	1000
12 × 8 × 8	3800	2900	2200	1600	1200
12 × 8 × 10	4500	3400	2600	1900	1450
14 × 9 × 9	5500	4000	3000	2300	1700

SMALL VERTICAL BELT-DRIVEN SINGLE-RAM PUMPS.

Pump.	Juice.	Scums.	Syrup.
2¾ × 2¾	120	90	70
3¼ × 3	180	130	100
3 9/16 × 3 3/16	230	170	130
4¼ × 4	350	260	200
5½ × 5	650	500	380
6 × 5½	850	650	500

slip-ring type, with speed-reducing resistances, whilst in any case, even when the speed of an A.C. motor is reduced, the power absorbed remains the same, the difference being merely wasted in the resistances.

Direct-acting pumps may perhaps be "steam eaters," but still most of the steam goes to the exhaust main, whilst in any case, the steam supply to such pumps is usually less than 5 per cent. of the total, so that the efficiency is a minor consideration; reliability, flexibility, and convenience are the important factors.

A Department of Overseas Trade Report states that under the agreement between the Egyptian Government and the Société Générale des Sucreries et Raffineries, their monopoly for the sale of sugar in Egypt was renewed in April, 1922, for a further year as from the following August 1st, subject to the price being fixed at £E. 35 per ton, subsequently increased to £E. 36 as from June 15th, 1922, by the revival of the excise duty of £E. 1 per metric ton on all sugar refined or manufactured in Egypt by mechanical means, which had been suspended since March, 1920. Fortunately for the consumer, however, the disposal of the company's surplus stocks, which necessitated the renewal of the agreement, will not occupy the entire 12 months, with the result that cheap foreign sugar will be available nearly three months sooner than was otherwise expected, provided the world's parity remains below Egyptian prices.

Problem of the Lowering of the Purity of Final Molasses in Java.[1]

By Dr. T. van der Linden.

Nature of Final Molasses.

An investigation on the nature of Java molasses, to determine whether it should be regarded from a chemical or from a physico-chemical point of view, and to what extent it can be considered to be exhausted, has been given special attention during the past seven years by the Chemical Department of the Experiment Station, which has arrived at the following results:—

(1) Proof has been furnished that Java molasses should be regarded as a saturated solution of sucrose, the sucrose content of which is determined by the influence exerted on the solubility by the different constituents, as invert sugar, salts, and other substances, either in the colloidal state or not.

(2) Experimental evidence has been given that the further exhaustion of Java molasses in general is possible, as may theoretically be deducted from the first result just stated.

Besides expressing our knowledge of the formation and nature of molasses in terms of modern science, and thus improving and extending our insight into the question, this investigation has taught us that from every molasses swung out of the centrifugal batteries under conditions almost generally in vogue there separates a quantity of sugar, which if brought into a recoverable form would constitute an additional yield by no means to be despised. In addition to proof of the possibility of further exhaustion, there is evidence that continued efforts on the large scale in practice would have a good chance of success from the economical point of view.

Significance of the Grain Content of Molasses.

Some figures will make this last point clear. Tests on the grain content carried out in 1919 by the Experiment Station with a great number of Java molasses showed that 79 of the samples examined had an average content of 8 per cent. In connexion with this result, it should be remembered that among these were a certain number of molasses having a small grain content which, however, was not the consequence of their more thorough crystallization, but rather of the fact that either before or during centrifuging they had been diluted with water more strongly than the others.

This grain is present in an irrecoverable form. If it were possible so to modify the method of working that this sucrose was deposited on the existing large crystals, an additional quantity of sugar amounting on an average to 8 per cent. of the molasses would be obtained. In Java the molasses produced yearly amounts to 7,500,000 piculs (456,000 tons), so that the extra quantity of sugar should be 600,000 piculs (36,480 tons), which at a price of F 10 per picul (£13 14s. 4d. per ton) would amount to 6,000,000 guilders (nearly £500,000), provided always that the method of recovery was not costly, and did not demand considerable alterations or additions to the plant.

Prinsen Geerligs' Criticisms.

With such an amount before one, there seems no doubt of unanimity as to whether the means of recovering this sugar would be worth the trouble. Before going into the matter further, the question will be raised whether the presence of such a high grain content in our molasses is a question of the last few years, and a result of less judicious working, so that greater attention in the factory would

[1] Paper read before the Chemical Section of the Java Sugar Technologists, 1922 Meeting, specially translated for this *Journal*.

suffice in order to recover the greater part of this sugar; or whether, on the other hand, we have to deal with a fact now first established in its entirety, though actually existing previously. Although all present will be convinced that the latter is the case, it would seem to be necessary now that the opportunity is presented to take up the matter, seeing that PRINSEN GEERLIGS in an article published in *De Suikerindustrie*[1] has delivered upon it an opinion which hardly flatters the work achieved in Java sugar factories in the domain of de-saccharification, or those who have conducted the work. Speaking of the determination of grain in molasses by KALSHOVEN[2] he said:

> If now one bears in mind how great an importance is attached in factory control to fractions of a degree of the purity, it is strange to note that now in a quarter of the cases differences of 10–14° are encountered, these being the result only of an incompletely conducted crystallization, which could have been avoided had crystallization been so conducted that the sugar had deposited on the existing crystals. This remark is by no means new, since in 1895 I demonstrated that by badly conducted crystallization very great losses of recoverable sugar had occurred, my opinion being summarized in the following words[3]: "These experiments showed that the centrifugal yield depends, not only on the quantity of sugar present in the massecuite, nor only on the quantity of crystals it contains, but also largely on the form in which these crystals occur."
>
> It is now very discouraging that after 25 years this same warning must be repeated when criticizing the centrifugal yield of final massecuites with a purity of 38·95°, whereas with a little more care and less speed a purity of 25° might have been obtained. Owing to the great losses occurring in boiling and centrifuging, we advocated the return of molasses and crystallization-in-motion, and the advantages resulting were very great, viz., a better crystallization and growth of grain, and an improved exhaustion. But now it would appear as though much of the gain thus acquired had once more been lost. Yet the question is quite a simple one. If the massecuite be so treated that its crystallizing out proceeds to the greatest possible exhaustion of the mother-liquor (which very generally happens), only part of the work is accomplished. One must take care to allow the sugar time to crystallize out before the massecuite is centrifuged, and the molasses thus separated. One must provide for a good circulation in the vacuum pan, and must not boil too quickly. Furthermore, the molasses massecuite must be slowly cooled off with long continued stirring before centrifuging is carried out. Only then can the full effect of the return of molasses, and of crystallization-in-motion, be expected.

It is much to be regretted that anyone of the standing of PRINSEN GEERLIGS should issue broadcast such a charge without at the same time producing documentary material other than the recently observed grain content, while the amount of this grain content in previous years cannot be known to him even approximately. It would have been more to the point if he had observed by how many degrees the purity had gradually risen since his departure from Java, as the result of the alleged inferior operation. This certainly should have been the case, if the large grain content is to be ascribed only to injudicious working.

PURITY OF JAVA MOLASSES IN RECENT YEARS.

In Prinsen Geerligs' "Handboek" one finds[4] the analyses of a number of molasses originating partly from molasses massecuites obtained by centrifuging, and partly from sack sugar obtained by draining. They are of the 1905 campaign, that is, shortly before PRINSEN GEERLIGS left Java; and the average purity of the centrifugal molasses amounted to 35·3°, while that of the drained product was 33·0°, the total average being 33·8°.

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[1] October/November issue of 1919. [2] *I.S.J.*, 1919, 608.
[3] *Archief*, 1895, 65; also see *Sugar Cane*, 1895, 182-195. [4] Pages 415-417.

According to the Mutual Control sheets, the average apparent purity of the molasses from factories taking part in this control has latterly been as follows:—

Campaign.	Purity.	Campaign.	Purity.
1914	32·8	1918	33·0
1915	32·5	1919	32·3
1916	32·4	1920	32·3
1917	32·6	1921	32·4

In 1905 the true purity (sucrose-Brix) of the centrifuged molasses was 40·2°, whereas this value in the years 1914-1921 was 36·4°. It is therefore quite clear from these figures that our molasses during recent years has not been less exhausted than in the last year of Prinsen Geerligs' residence in Java; and that it will not do to ascribe the large quantity of grain appearing in molasses after their working to lack of care, to haste, and to injudicious operation. Nevertheless, I will not dispute the view expressed in his article that boiling and crystallizing are conducted too quickly. Actually, this is so in many cases; and it occurs at the cost of the exhaustion of the molasses. But I do not agree that this has been the case to a greater extent during recent years, otherwise it would have been distinctly demonstrated by the purity of the molasses.

Testing the Solution Theory.

After this digression, which I have considered necessary for the reputation of those who have supervised factory work during past years, and are still so doing, I return to my main discussion. The fact that molasses is an ordinary saturated sucrose solution (and not an eutecticum, undercooled or otherwise) implies that on cooling any molasses the sucrose must separate out, provided there is no impediment to crystallization, and that the purity of the mother-liquor or that of the molasses surrounding the crystals will therefore diminish. For the same reason, by further concentration of any molasses, sucrose must crystallize out, so long as the isotherm solubility curve shows no minimum (and the results obtained so far by Kalshoven prove that such a minimum does not occur within a relatively wide limit). On these grounds *theoretically* the extent of the possible lowering of the purity is very great; but the boundary in theory is far beyond that in practice. Having been a scientific problem, it has now become a technical one; and the formation of molasses of considerably lower purity than the present Java product has become resolved into a question of technique.

With the help of the experimental installation at Sroenie, consisting of a small serpentine pan of 90 h.l., two Bock crystallizers, and four centrifugals, we commenced in 1920 and 1921 campaigns an enquiry on the practical scale to the following questions:—(1) How must one proceed in order to obtain from molasses massecuites as much sugar as possible in a recoverable form; and (2) how may this mode of working best be carried out with the existing installations; or what are the smallest possible modifications by which the plant now in use may be adapted to this mode of working?

As already explained, the statement of the fact that molasses is a simple saturated sucrose solution has involved the following two consequences:—(*a*) The higher the Brix of a strike on centrifuging, the lower will be the purity of the molasses obtained; and (*b*) the lower the temperature of the strike on centrifuging, the lower will be the purity of the molasses obtained.

Hence, it may be stated that molasses of the lowest purity will be obtained by allowing the strike at the highest possible Brix to cool to the temperature of the factory, say about 30°C. (16°F.), the molasses then being separated from the crystals without the grain already separated being brought into solution again by any manipulation.

CENTRIFUGING MASSECUITES BOILED TO A HIGH BRIX.

This last condition is not so simple. If the attempt be made to centrifuge in the ordinary way a cuite which has thus been cooled, either the operation will be found impossible, or else it will demand so many machines as to prove unremunerative. In order to be reasonably successful, the Brix of the strike must be quite high, so high, indeed, that the massecuite in the trough is just movable. For this reason the massecuite may not be diluted with water during its cooling in order to make it capable of being centrifuged.

But an expedient, based on the following considerations, is adopted:—Solution of the sucrose takes time, and if one were to use as a diluent an almost saturated solution of sucrose, solution would only occur quite slowly, especially with well-formed crystals and at ordinary factory temperatures. Molasses diluted with a very little water provides such an almost saturated solution of sucrose. Mixing the well-cooled cuite with this molasses directly before centrifuging should make the mass easily workable, while the time necessary for mixing and centrifuging should not be long enough for the solution of any appreciable amount of sucrose. If in this short time some crystal were to pass into solution, one would expect that this effect would be confined to any fine grain present, which anyway would mainly find its way back into the molasses, so that the ease of centrifuging would be increased.

Some preliminary laboratory tests showed this order of reasoning to be correct. By quickly mixing a cuite cooled to the ordinary temperature with molasses at 83–85° Brix in the proportion of 3 : 1, and afterwards aspirating off the molasses, no appreciable quantity of crystal had apparently gone into solution, while the purity of the molasses thus obtained was 4° lower than that used for the mixture.

METHOD OF WORKING ADOPTED.

On the ground of these considerations and results, the following method of working was elaborated, and was put into practice by means of the experimental installation: Molasses strikes were boiled off to such a Brix that they were just movable after being cooled in the Bock crystallizers. When they had reached the ordinary temperature of the factory, while adding molasses at about 85° Brix directly under the outlet of the Bock crystallizers in an amount enough to make them sufficiently transportable, they were centrifuged. Following this procedure a couple of score of strikes were worked up, and at the same time the course of desaccharification while the temperature was falling was followed by taking of small samples.

It was found that (in accordance with the theory) in all the strikes (the Brix of which varied from 95 to 98·5°) the lowering of the temperature coincided with the fall of the purity. It was also observed that as a whole (some exceptions not considered), with the massecuites having a high Brix, the purity both during cooling and on reaching 30° was lower than with the massecuites having a low Brix (once again corroborating the theory). Massecuites having the high Brix mentioned on being mixed with the diluted molasses appeared to have the requisite fluidity; and the quantity (which averaged 15–16 h.l. for a strike of 90 h.l.) seldom had to be increased. In fact, the quality of centrifuging, as far as one could see (exact figures regarding this being lacking), was in general not inferior to that in the present manner of working, the time of swinging out not being longer than with a normal battery in ordinary practice.

RESULTS OBTAINED.

The average apparent purity of the molasses obtained from these massecuites amounted to 28·5°, and the sucrose-Brix purity was 31·6°. In each case one also determined the purity of the molasses from massecuites, which, simultaneously with the experimental strikes, had been worked according to the customary method. Their average was 30·4°, so that we can say that by the modified manner of working, molasses having a purity of 1·9° lower is obtained. At first sight this decrease does not seem much; but we wish to point out that this average decrease in purity was the result of a series of tests with an installation and with conditions that were certainly not more favourable than with most factory installations.

We are convinced that, by strictly following this method of operating, a yet greater gain in the purity may be expected, and more than one example of this was to be found amongst the experimental tests. If this conviction holds for Sroenie, then in the case of many other factories the success will be still greater, and indications of this are to be found in the following facts: The purity of the molasses is already on the low side, having been 33·7° (sucrose-Brix) in 1920, and 34·7° in 1921, both of which values are distinctly lower than the general average for Java. Further, the grain of its molasses when examined in 1919 had the low content of 5·8 per cent., although the Brix was not particularly low. In these two facts we think we may see an indication that, in factories having molasses of high purity and high grain content, greater success may be expected with the modified method of working than in the preliminary tests made at Sroenie. If this method were operated in the right way in all Java factories, an average fall in the purity of the molasses of certainly 3–4 should be obtained, corresponding to a grain of about 300,000 piculs (18,240 tons) of sugar.

NECESSARY MODIFICATION OF THE PLANT.

Regarding what is necessary in order to realize this, it has been stated that both the method of boiling and centrifuging would remain the same, the only important modification necessary in the installation being the considerable expansion of the cooling capacity to the extent that the time available may be three to four days. In a sense the time of cooling can hardly be long enough, since the longer the time, the more slowly crystallization occurs, and the more certainly will the lowest degree of purity be reached without the formation of false grain. But for a factory having a milling capacity of 10,000 piculs, the installation should consist of a vacuum pan delivering 300 h.l. of molasses massecuites per day with five or six crystallizers of 300 h.l.

Summarizing, therefore, it is seen that, confirmed by the results of this experimental investigation, theory teaches that molasses of the lowest purity is obtained from massecuites having the lowest purity and the highest Brix when these were centrifuged at the lowest temperature. It is the task of the practician to determine to what extent this may be realized in the factory with the available technical equipment in a remunerative manner.

A Reply by Dr. H. C. PRINSEN GEERLIGS.

I fail to see the reason why DR. VAN DER LINDEN should complain of the criticisms made by me years ago in *De Suikerindustrie*. He admits that nowadays in many cases boiling is conducted too quickly, and cooling too slowly, and that such methods are detrimental to the proper exhaustion of the molasses. He thereby confirms my objections.

His reproof that I may not pronounce a criticism if I am not able to show that the purity of the exhausted molasses is higher now than twenty years ago is not deserved. During these last twenty years methods for the clarification and filtration of juices have been greatly improved, and these modifications must conduce to the removal of sticky substances from the juice and to the reduction of the viscosity of the molasses. In the second place many sugar factories have renewed their vacuum pans and air-pumps, and are now able without fear of charring to boil down their last massecuites to concentrations not to be thought of in my time. One might therefore expect the average quotient of purity of the exhausted molasses to be much lower now than in the day when I published my investigations on molasses.

DR. VAN DER LINDEN says in his paper that if one should succeed in recovering the large amount of minute sugar crystals present in the exhausted molasses of these days, the quotient of purity would be sure to go down to a large extent. This is just what I intend to convey when I say that it is the fault of the present generation that they allow all that sugar to be lost. It would appear as if they have not completely availed themselves of the advantages offered them by improved methods of clarification and improved boiling-house appliances.

DR. VAN DER LINDEN advocates the extension of the cooler plant, in order to allow more time for the last crystallizing sugar to adhere to the already formed crystals; and he also advises the mixing of the cold massecuite with molasses diluted to 85° Brix just before centrifugalling.

This proves (just as I pointed out) that actually the last massecuite is not given the proper time to crystallize out fully; and that if only more time were granted to the cooling-in-motion of the last massecuite, the particles of sugar crystallizing out slowly from that highly-concentrated mass would deposit themselves on the surfaces of the already existing crystals, and would no longer form separate minute grains to be spun off in the centrifugals along with the molasses and thus be lost.

The dilution of the tough, cold, massecuite with molasses diluted to 85° Brix, which is known not to dissolve sugar crystals, is a secondary operation which does not comprise anything new. On the whole, it may be said that the remedy suggested by DR. VAN DER LINDEN, with which I fully agree, is more a confirmation of my criticisms than otherwise.

Sugar Production in British Guiana.

(American Consular Report).

The British Guiana Sugar Planters' Association has recently completed a statement of the acres of cane reaped and tons of sugar made on the various estates in the colony during 1920, 1921, and 1922, with estimates for 1923. The report shows that the production of sugar in British Guiana was 96,240 long tons in 1920, 107,815 in 1921, and 101,128 in 1922. The 1923 crop is estimated at 95,494 long tons. The area of cane harvested was 53,334 acres in 1920, 55,159 acres in 1921, and 53,750 acres in 1922, with the 1923 average estimated at 51,445. (Figures on acreage represent Rhynland acres, equal to 1·235 English acres). While the acreage harvested during the years under review has registered a slight decline, it appears that recent crops have varied according to temporary conditions and on the whole have not been below the general average Improved machinery and better methods of cultivation have raised the yield of sugar per acre of cane reaped and may continue to do so. However, it is not probable that under present labour conditions the total annual crop of sugar produced in British Guiana will be greatly increased.

Recent Work in Cane Agriculture.

Dry Top Rot of Sugar Cane: A Vascular Disease. *Julius Matz. Journal of the Department of Agriculture of Porto Rico. Vol. VI, No. 3, July, 1922. (20 pp.)*

This disease has been under observation in Porto Rico since 1919, and in 1920 the author traced it to a parasite which he named *Plasmodiophora vascularum n. sp.*[1] Its separation from the various other top rots of the sugar cane is clearly worked out in the present paper, showing that there is no definite account of its occurrence elsewhere, but the descriptions are in some cases incomplete. As regards the effect of this disease on the yield of sugar in the island Matz considers it the most serious of the three or four major diseases in Porto Rico, being especially evident in poor yielding ratoon crops. In many cases he has shown the presence of dry top rot, and he regards it as the main cause of such failures in the ratoons, causing an estimated reduction of 25 per cent. in the yield over considerable areas during the 1921-22 season, and has noted it in all the best varieties. Without previous signs, when nearly mature, the leaves turn yellow and begin to dry up from the middle to the top ; this is also met with as a result of insect injuries (especially borers), lack of drainage and deficiency in plant food, but *Plasmodiophora vascularum* is independent of all these and occurs in good soil and in the absence of insect attacks. The severity varies in different years, but the last three have been favourable to its development.

The following are the symptoms :—Loss of green colour, rolling in and wilting with drying of the tips of the leaves in the central whorl, followed in severe cases by the death of the upper joints, caused by a dry odourless decay of the top of the stem, being really a premature drying up of the leaves and joints by a clogging of the vessels by a foreign organism. The drying of the leaves often begins with dead grey longitudinal stripes, 1 cm. wide, at about the middle of the inner leaves along or near certain bundles. An especially important character is the coloration of the bundles, usually orange or yellow but sometimes pink or even red, and caused by the orange coloured spherical Plasmodiophora spores and the yellowish younger stages, contained in the vessels of the subterranean parts of the stem and roots. These characters are not recorded for any other sugar cane disease. The water content of the soil may have a direct influence on the appearance of these external symptoms, for in wet weather they are often not noticeable but immediately appear when the soil commences to dry. In other diseases the coloration of the tissues is usually accompanied by hyphae in the tissues generally, but these are entirely absent in dry top rot; there is no direct decay, and only the vessels are invaded. The disease has probably been present for some time in Porto Rico, for instance, the observation of tip withering by Johnston and Stevenson during 1911-14 ; but, as the author remarks, it is comparatively unimportant to attempt to trace its previous history in the island.

Experiments were conducted as to the transmission of the disease through the sets. (1) The organism *Plasmodiophoria vascularum* was teased out and inserted into the root eyes of healthy sets ; the resulting stools were stunted and showed symptoms of dry top rot, but the organism was not recovered from the bundles. (2) Fifty infected sets of Rayada and 100 healthy ones as control were planted out in land that had not had sugar cane grown on it for many years. In the former the plants at first showed no signs of the disease but, when three to four months old, the shoots began to dry up and die although no Plasmodiophora

[1] *Ibid. Vol. IV, No. 1, 1920.*

was found; at seven months, however, dry top rot appeared and Plasmodiophora was found in 40 out of 115 canes produced. In the 100 control plants there were 4–10 canes per plant, and these were taller than in the other series and perfectly healthy. It may be noted here that the growth and progress of the parasite is extremely slow, as one might expect from its mode of increase. Direct experiments as to transmission through the soil had not been completed when the paper was written, but certain observations had been made. (3) *a.* Cristalina canes were introduced from San Domingo that were noted for their vigour and three crops were taken; these grew well, but in the third (2nd ratoons) five clumps showed dry top rot in one corner of the field. *b.* A field on the south coast was noted as always being heavily infected by dry top rot, although constantly supplied with fresh vigorous seed. *c.* A two to three year old seedling at the Insular Experiment Station has developed *Plasmodiophora vascularum* in both stem and root. Thus the disease has been proved experimentally to be passed on by diseased sets, and this is probably the main way in which it is spread, but it is possible that it may also be passed from plant to plant through the soil.

The author then makes a detailed comparison with other diseases showing correlated phenomena. In *Sereh*, the red colouring of the bundles is usually to be met with around the nodes and does not enter the internodes; in dry top rot the colouring is more usually orange or yellow, is generally found in the basal parts of the plant and passes through node and internode. The substance in the bundles is also of a different nature and spherical spores may easily be pressed out and broken up. *Root disease* in Porto Rico is, according to F. S. EARLE, a collective name embracing phenomena which might be due primarily to an affection of the roots by one or more obligate parasites or to defective agricultural methods which enable the facultative parasites to attack the already weakened plants: it would thus include dry top rot in so far as this affects the roots, besides any other disease which would produce similar results. *Gumming*, at present rather common in Porto Rico, is easily distinguished by the curious colouring of the leaves and, later, by the exudation of gum on the surface of cut canes.[1] KRUGER (1899) mentions a non-infectious top rot in which the young unrolled leaves are first attacked, turn brown and die, the older following later; the vegetative apex also turns brown and when cut emits an offensive odour. VAN GORKUM describes a top rot in Brazil in which the apex of the stem is tightly enclosed by the leaves and becomes folded and crinkled. This was however rare and the plants subsequently recovered. BUTLER in India (1913) describes a wilt caused by *Cephalosporium sacchari*, and this was afterwards found by DASH in canes in Nevis, with hollowing of the stem and fungus hyphae in the tissues, neither of which occur in the dry top rot of Porto Rico. COOKE and HORNE mention a drying out of the cane with the following symptoms: "Many of the stalks of these diseased plants have made an apparently good growth of several feet, but the leaves are thickly clustered at the top, and a rot is found passing down along the inner or younger leaves to the top of the stem." The illustration suggests to MATZ a strong similarity to dry top rot.

Summarizing, he concludes that a brown top rot or dead heart, causing discoloration and decay of the tender tissues of the top of younger cane, is described by KRUGER in Java, EARLE in Porto Rico and VAN GORKUM in Brazil, and is attributed to borers or overshadowing of young shoots or other not fully determined physiological interferences. Bacterial top rots also occur, one being known to be caused by *Bacterium vascularum*, the gumming organism; MATZ considers it

[1] For a summary of the symptoms of gumming in Porto Rico, see *I.S.J.*, 1923, p. 426.

probable that there are other bacteria capable of causing the decay of the cane top. Then there are the Cephalosporium wilt, wither tip recorded by JOHNSTON and STEVENSON, and the drying of the top described by HORNE and COOKE. The last two are regarded as perhaps the same as the dry top rot described in the paper under review.

The knowledge as yet obtained of its distribution in Porto Rico is founded on the presence of *Plasmodiophora vascularum* in the vessels. It was first noted in Cavengerie, and afterwards in Rayada, D 109, Cristalina, Yellow Caledonia, a Porto Rico seedling, and Otaheite. Is is more commonly met with in Rayada, but this does not imply of necessity any special susceptibility of that variety. Rayada is most widely planted and, because of its sweetness, little is left over after milling, and even diseased ratoons are sometimes used for its propagation.

The systematic position of *Plasmodiophora vascularum* is gone into in some detail, and the author ends up with the following: "The behaviour of *P. vascularum* is not indeed like *P. brassicae*, nor is it like any of the Plasmodiophorales, especially when its partiality to the interior of the cane fibres is considered. But it possesses no marked feature which would throw it definitely into another group."[1] The main line of fighting the disease, as might be expected, is a careful selection of planting material. No seed should be taken from diseased fields and preferably only the upper parts of the cane should be used, because the organism is usually confined to the lowest portions. Perhaps the best seed would be obtained from tops of 6–7 months old plants, which would almost certainly be sound still. Soil known to be diseased should be rotated with legumes or other crops, as the organism has not been as yet found in any other plant than the sugar cane.

DEPRECIATION OF CANE CAUSED BY FIRE AND BY DELAYS IN SHIPPING. *F. A. Lopez Dominguez. Insular Experiment Station, Porto Rico. Bulletin No. 30. 1922. (52 pp.)*

These investigations which were extended, year by year, for three successive seasons (1919–1921), were primarily conducted to form a basis from which to judge the compensation to be paid by the railway for accidental fires caused by locomotives passing through the cane fields. After each season the data obtained proved to be insufficient for the courts, and thus fresh experiments were introduced.

In 1919 the experiments were designed to show the losses in weight and in sucrose incurred by burning canes, both when left standing in the fields and when cut and piled after the fire. For this purpose a plot of about one quarter of an acre was selected and 48 canes were cut and topped, 31 of Cristalina and 17 of P.R. 209: each cane was weighed and then returned to its position in the clump, being wired to an adjoining cane and left standing; the whole was then fired. Re-weighing each cane after it had been allowed to cool gave the loss suffered in burning. A cartload of canes of each variety was then cut and these were piled separately in the yard of the laboratory. From each of these piles, five canes were taken on each successive day, ground together and analysed, and simultaneously five canes were taken of each variety from those left standing in the field and treated in the same way.

In 1920 the experiments were planned to obtain data as to deterioration, both of the burned and unburned canes when cut and piled for several successive days before grinding. Also further data were required as to the loss in sucrose in standing as compared with cut burned cane. Tests were extended to include

[1] See, however, Bourne's remarks on a similar organism found by him in Barbados, mentioned on page 516.

losses in weight on successive days. A plot of cane nearly half an acre in extent was chosen, and the field was divided into two equal parts by a cleared path right through the middle of the plot, one being burned and the other not. From the plot to be burned 48 canes were taken as before and weighed before and after burning, and also weighed on successive days, being kept exposed to partial sunlight, as they would have been if left piled in the field. Two cartloads were taken from the two halves of the field and treated as before, acidity being left out in the analyses.

In 1921 one more item was introduced, namely, the loss in weight incurred by unburned cane when cut and piled. A plot of about one-quarter of an acre of Yellow Caledonia was selected and divided into two parts by a path similarly to the previous year, but 50 canes were taken from each plot, those only being replaced temporarily in the plot to be burned. These 50 canes from each plot were weighed individually and all together, on successive days, being kept in partial shade meantime. As in the previous year a cart-load was cut from each plot after the one had been burned. and daily samples of five canes taken and examined. The analyses this year were, however, more complete and included extraction, acidity, sucrose and reducing sugars; the data obtained were thus the most complete of the series and supplemental to those in the first two years.

The results of each experiment are duly recorded in the body of the paper, and a discussion is added of the results of each year and another of the combined results of the three years. The following summary of the work is given at the end of the pamphlet. (1) When subjected to fire while standing in the field the canes in these experiments lost, in round numbers, 2 per cent., more or less, of their original weight. (2) On storing burned cane, it lost weight at the rate of about 2 per cent. of its original weight per day. (3) The lighter canes, both when burned and not burned, lost proportionately more in weight than the heavier ones, upon being stored. (4) The loss in weight caused by storage was greater in the burned canes than in the unburned. This excess loss was calculated to be equal to 0·64 per cent. of the original weight of the cane. (5) The burned cane suffered inversion both when cut and when left standing in the field, but the standing cane suffered greater losses in sucrose than the cut cane. This excess loss amounted to 1·35 lbs. of sucrose per day per ton of cane for a five days' period, and to 4·53 lbs. of sucrose per day per ton of cane when the period of observation was extended to eight days. (6) When cane was cut without burning and piled, it lost sucrose through inversion to the extent of 6¼ lbs. of sucrose per day per ton of cane during a period of storage of five days. This loss is less than that suffered by the burned cut cane by 1·84 lbs. per day, and less than that undergone by the burned standing cane by 3·19 lbs. per day per ton of cane, for the same period of time.

REPORT ON THE DEPARTMENT OF AGRICULTURE, BARBADOS, 1921-2.

The chief items of interest to sugar planters in this Report are the statements of the Director of Agriculture, J. R. BOVELL, that Mosaic occurs practically all over the island, and of the Assistant Director, B. A. BOURNE, that *Marasmius sacchari*, long credited with being the direct cause of the root disease in the West Indies, may have nothing to do with it, thus falling into line with recent work elsewhere, especially in Porto Rico.

The Director reports that Mosaic was first discovered by R. C. MCCONNIE, a visitor from Porto Rico, in a small plot of peasants' cane in October, 1920, and pointed out to BOVELL. The following is a résumé of the steps taken. The

planters were at once made aware of its presence and cautioned in a letter to the local press, the Governor of the island was informed, and the Assistant Director made a survey which resulted in its being found in various places in one parish only. A Commission was appointed in January, 1921, and presented its report with recommendations on March 2nd, and this was laid before the Legislative Assembly three months later, when an Act was passed; there was, however, some delay in printing this Act. Five Commissioners were then named, and an inspector was appointed on January 11th, 1922. Shortly after this appointment the disease was discovered to have spread so rapidly that two more inspectors had to be appointed. The Director reports that Mosaic occurs practically all over the island.[1]

The Assistant Director, reporting on entomological and mycological work in connexion with sugar cane, mentions that *Sipha flava* was found during the year in a locality remote from that where it was found last year. The moth-borer still causes considerable loss, and its egg parasite *Trichogamma minutum* appears to be unable to check it efficiently. He suggests a careful hunt for the egg masses of the moth-borer and the breeding out of these in the fields in tins surrounded by water; the emerging grubs would thus be destroyed while the Trichogamma, freed from the parasitized eggs, could fly away and continue its beneficient work. There was no improvement in the situation as regards the damage caused by root-borer (*Diaprepes abbreviatus*) and the brown hardback (*Lachnosterna smithi*).

The root disease was the most serious one appearing during the year, and the Assistant Director spent a considerable time in its examination, the results being brought together in a Bulletin.[2] In the present publication merely a summary account is given, together with some recommendations. It was found not to be confined to any specific type of soil, but occurred both on typical black and on red soils. Plant canes were not usually attacked to any noticeable extent but ratoons appeared to be specially susceptible. In typical cases of the disease either *Rhizoctonia solani* or *R. palida* were found associated with freshly diseased or dying cane roots, in advanced stages the bases of the shoots being also infected. Sometimes a Fusarium was also met with. In inoculation experiments both of the former were found to be parasitic, each being proved to be capable of inducing root decay with typical symptoms of root disease, namely, stunting of the plants and yellowing of the leaves; under the same conditions the control plants showed no such pathological symptoms. Meanwhile inoculations with *Marasmius sacchari* and Fusarium gave only negative results.

Conditions of high temperature, combined with lack of moisture, were found to favour the disease in the field. The usual recommendations of selecting resistant varieties, planting only cuttings from healthy parents, suitable rotations for "forcing the fungi to live saprophytically and thus reduce their virulence," proper drainage, tillage and aëration of the soil, together with proper trashing of the fields of young plant canes and ratoons, so as to conserve moisture and keep down temperature, are those given in the present Report.

A new fungoid disease, known as eye spot, appeared in force on the leaves of a 4½-acre field of BA 10 (12). At first small red spots appeared which spread rapidly, chiefly in the longitudinal direction especially towards the tips of the

[1] The procedure described by the Director appears to be somewhat cumbrous, but it is to be doubted whether the spread of the disease was so rapid as is inferred It is possible that Mosaic has been present for some time in Barbados, but working in an inconspicuous manner, and that certain local conditions have brought it into prominence.—C. A. B.

[2] This Bulletin is reviewed on another page in this issue.

leaves, sometimes running together to form long streaks. The centres of these spots soon changed to a dirty straw, with a red margin ultimately becoming dark brown. In advanced stages of serious infection, only a few linear, irregular, yellowish green areas were left, the remaining leaf surface being occupied by the eye spots. The field in question was so seriously attacked that even from a distance it presented a blasted appearance. The fungus was isolated and agreed with the description of *Helminthosporium sacchari* described from India by BUTLER, but in the cultures the spores appeared to be much longer than those mentioned by that author. *Colletotrichum falcatum* was found associated with the diseased spots, and the author believes that this was largely responsible for the rapid death of the leaves.

Another Porto Rico fungus was recorded from Barbados during the year, namely, *Rhizoctonia grisea*. It was isolated in pure culture from a single sclerotium taken from a dying leaf sheath of BA 6032. MATZ in Porto Rico found that this fungus was capable of destroying tender cane leaves as well as the roots.

C. A. B.

Overseas Trade Reports.

EUROPE.

The *Prager Presse* of 18th September, in a report forwarded to the Department of Overseas Trade by the Commercial Secretary at Prague (Mr. E. C. D. Rawlins), states that all the estimates of the new sugar beet harvest have been completely knocked on the head by the unusually dry weather. From all countries of Europe growing sugar beet disappointing results are reported, and even the official analysis does not give a true picture of the existing conditions, resulting from the dry weather. Italy, which began its sugar campaign under ideal conditions, reports its harvest as far below the original estimates.

CZECHO-SLOVAKIA.

In Czecho-Slovakia the sugar beet analysis is a far more favourable one than in the two preceding seasons. On the 10th September the sugar beet situation was as follows:—

	In Bohemia.		In Moravia, Silesia, and Slovakia.		In the whole Republic.	
	1923.	1922.	1923.	1922.	1923.	1922.
Weight of the root	376	399	428	355	393	385
Weight of the leaf	304	427	360	295	323	385
Sugar content per cent.	18·18	16·15	17·56	17·04	17·98	16·44
Sugar in one beet	68·3	64·4	75·1	60·5	70·6	63·3

It is stated from several sources that the harvest per hectare will not be larger than in the past season, and that the coming campaign will only be larger in the degree to which new ground has been put under cultivation. This statement is justified by the figures mentioned above as far as the weight of the root is concerned. As, however, the slicing of sugar beet has started in Moravia, it presents the most disappointing results. A harvest of 130 quintals per hectare is reported, as against 230 quintals last year. It is certain that the average result of the harvest will come out better, but this is a typical example of the disastrous influence of the dry weather. The ground is so hard that it is almost impossible to break it up.

The 1922-23 Cuban Sugar Crop.

Details of the Output.

(After Guma and Mejer's Report.)

The following are the crop figures of the Cuban provinces for the 1922-23 season just closed. The individual outputs of the twelve largest factories are also appended.

PROVINCES.

	Centrals.	Bags.
Havana	21	1,790,197
Matanzas	20	1,914,157
Cardenas	17	2,245,449
Cienfuegos	19	1,874,644
Sagua	14	1,097,829
Caibarien	14	1,605,898
Guantanamo	8	535,131
Cuba	7	835,099
Manzanillo	8	684,415
Sta. Cruz del Sur and Manopla	2	466,274
Nuevitas, Pastelillo and Pto. Tarafa	25	5,618,192
Antilla and Tanamo	12	1,671,265
Nipe Bay	1	378,275
Jucaro, Palo Alto and Boca Grande	5	1,921,959
Puerto Padre and Vita	3	1,410,021
Banes	1	355,325
Manati	1	534,628
Zaza	2	42,490
Casilda (Trinidad)	2	209,120
Total centrals	182	
Total bags		25,220,368
Total tons		3,602,910

LEADING FACTORIES.

Central.	Province.	Bags.
Delicias	Puerto Padre	777,080
Moron	Jucaro	600,833
Cunagua	Nuevitas	587,085
Jaronu	Nuevitas	577,230
Manati	Manati	534,628
Chaparra	Puerto Padre	477,540
Baragua	Jucaro	440,904
Stewart	Jucaro	439,484
Violeta	Nuevitas	423,516
Punta Alegre	Caibarien	402,852
Espana	Cardenas	395,421
Jatibonico	Nuevitas	388,119

An invention of great value, particularly to chemical engineers, is the "Metallization" process of coating any surface with any metal or alloy, such as aluminium, zinc, lead, tin, copper, brass, bronze, etc. The coating metal in the form of a wire is melted by an oxy-hydrogen or other flame, and projected by a "pistol" on the surface to be covered, which if metal must be preliminarily cleaned by sand-blasting. This process may be applied with advantage to: Iron and steel work, to prevent corrosion; pipes and tanks, to protect them against the attacks of acid solutions; telegraph posts and other woodwork, to ward off the ravages of insects, or to delay the effect of fire; firebars and other parts of boilers (using aluminium), to increase their life; and for other purposes, a number of which will immediately occur to the reader.

Publications Received.

The Cultivation of Sugar Cane in Java: An elementary Treatise on the Agriculture of the Sugar Cane in Java and more especially on its Cultivation on the Krian Sugar Estate. By R. A. Quintus, Manager, Krian Sugar Factory. xii. + 168 pages, royal 8vo. With seven coloured and 32 double tone plates and 23 illustrations in the text. (Norman Rodger, 2, St. Dunstan's Hill, London, E.C. 3.) 12s. net (post free abroad, 13s.)

As he remarks in the preface to his new work, Mr. QUINTUS, manager of the Krian sugar factory in the island of Java, has described, in what must be considered a handsome book, the planting instructions compiled by him for his estate, which are the outcome of many years of practical experience and research. Although these instructions chiefly refer to the local and cultural conditions prevailing in Java, and in particular to his part of the island, the principles on which they are based are universal, and may be of great value to cane planters in many other cane-growing countries in the world.

The book is divided into two parts, of which the first deals with the conditions in Java and the theory of cane cultivation, while the second contains an exhaustive survey of the practice of cane cultivation in that island.

Mr. QUINTUS describes the climate, the geology, the formation and properties of the soil, and the irrigation schemes in the districts where cane is cultivated, more especially in the Sidoardjo delta where his factory is situated. A section on leasehold and crop rotation shows clearly how, owing to the peculiar conditions prevailing in Java, the planters of that island are obliged to practise a very intensive cultivation of the soil, which has finally come to look very much like horticulture. The consequence of only disposing of a very restricted area of land, which is not the property of the estate, but is rented from the native inhabitants for a period of short duration, forces the planters to devote all their attention to keeping up, and, if possible increasing, the production per acre, which is only possible by faithfully executing all the operations; these remind one more of the methods practised in nurseries and botanical gardens than in cultivation on a large scale. A well-authenticated chapter is devoted to the morphology and the physiology of the cane, to the formation of sugar in the plant and to the propagation of sugar cane, in which the questions of heredity and sexual selection are clearly discussed. Manuring, treatment of the cane, and a good description of the diseases to which cane is exposed, and the methods to combat them, form another section of the work, while the first division is concluded by a dissertation treating of the conditions on which the yield depends and the factors influencing them. Mr. QUINTUS summarizes the result of his investigations on the following lines:

> Cane production depends on the number and the girth of the stems; that is to say, as the number and the girth of the stems increase, cane production will be larger.
>
> The more regularly and normally growth has proceeded, the greater will be the accumulation of sugar.
>
> Sugar production depends on the condition to which the soil can be brought and kept, on the date of planting, and on climatic circumstances.

The second part of the work is devoted to the practice of cane cultivation. It starts with the classification of the soils and the methods of draining and irrigating the various types of soil by means of systems of trenches and gutters. Next the treatment and disinfection of the planting material are considered, together with the various methods of planting the tops for the different classes of soil. After a good review of the work to be done in the fields till the ripening of the cane, such as banking up, weeding, trashing, combatting insect pests, and so on, Mr. QUINTUS describes the methods in use for the determination of the point of maturity of the sugar cane. Smaller sections on harvesting and transport of the cane, book-keeping, supervision and labour, and cost of production, form the final pages of Part II, while the book is concluded by statistics and diagrams showing the position which the Java sugar industry occupies in the sugar world.

Mr. Quintus' book is lavishly provided with beautiful illustrations, most of them from original photographs taken by the author himself, and further by plates, coloured and black, put at his disposal by others. The book gives a very good idea of the ways and means used in Java for raising the rich cane crops for which that island is celebrated; and Mr. QUINTUS is convinced that no practised planter, in whatever part of the world, will find any difficulty in judging how far the methods described by him may be copied.

We fully agree with Mr. QUINTUS in this opinion, and are confident that the book under review will prove very useful for every student of scientific cane cultivation.

H. C. P. G.

Concerning Sugar (Loose Leaf Service). by Truman G. Palmer. A Series of Loose Leaves incorporated in an Expanding Binder with Tab Index. 11 in. × $8\frac{1}{2}$ in. Price by private subscription: \$12 per annum, plus cost of Binder \$3. (Truman G. Palmer, 901, Union Trust Buildings, Washington, D.C., U.S.A.)

We have already had occasion several times to refer to this excellent series of loose leaf records which aim at giving to their subscribers from time to time particulars as to the history and statistics of the sugar industry in various parts of the world. New issues come out at intervals, while fresh issues are frequently sent out in revised form and brought down to date to take the place in the loose leaf binder of earlier issues on the same subject.

Two recent issues are on Japan and on Mauritius. The former includes a map of the island of Formosa (Taiwan) on which are marked all the modern cane sugar mills as well as all lines of transport. A brief history of the industry in Japan and its dependencies is given, as well as some particulars of the industry as now carried on. Finally, statistics are given enumerating *inter alia* the modern cane mills in old Japan and Formosa, the sugar refineries in old Japan, and the beet sugar factories in old Japan, Manchuria and Korea. Much the same sort of information, including a map, is given in the section relating to Mauritius.

It may be remarked, though, that in both cases the production is given for the various periods in American short tons, so is not so readily adaptable for English readers. It is a pity that international statistics relating to sugar cannot be all given in one and the same weight unit. Messrs. Willett & Gray, the New York Statisticians, stick to long tons for their estimates, and so do Messrs. Guma & Mejer, the Cuban authorities. In England, a different complication arises from the fact that official figures are invariably given in hundredweights (for purposes of publication in this journal they have to be converted by us into long tons) and all attempts to induce the authorities to give them in tons like the rest of the sugar world have failed. The American authorities on their part stick to short tons or else lbs. So comparisons of production will, we suppose, continue more or less confused, which seems a pity.

The Worshipful Company of Grocers: An Historical Retrospect, 1345-1923. By J. Aubrey Rees. 189 pages, 8 Plates. (London: Chapman & Dodd, Ltd., 66, Gt. Queen Street.) 12s. 6d. net.

A short history of one of the City Companies, the Company of Grocers, which ranks as second in importance among the Livery Companies of London, from its inception in 1345 down to the present day. It is pointed out that there are few trades or professions demanding such a variety of knowledge as that of a grocer. Analysis, chemistry, the refining of raw materials, expert salesmanship, the art of purchase, and tasting and blending, are but a few of the subjects which are necessary in the training of the modern grocer. At the present day the Grocers Company enjoys an annual revenue from lands, property, etc., of some £40,000 per year, and is one of the foremost institutions of the day in the support of charitable and educational institutions. As an instance, they subscribe £1000 annually to the City and Guilds of London Technical Institutes.

Brevities.

Among the many interesting exhibits at the recent Engineering Exhibition, held at Olympia, London, was the Hele-Shaw "Stream Line" filter, which, with dyes, milk, beer, raw sugar solutions, and the like, yields an absolutely colourless solution, from which, in some cases, not only colloidal solutions of colouring matters, fats, proteins, and pectins have been removed, but in some cases molecular dispersoids, viz., sugars.[1]

It is stated by KURT BRAUER[2] that, using beet molasses (previously submitted to a clarifying treatment), and fermenting by means of a special yeast with strong aeration, a quality of spirit can be produced, which can hardly be distinguished from that known in Germany as Batavia arrak, in respect of taste and analytical constants. Some particulars of the method of fermentation and distillation, and analyses of the products obtained, are presented by him.

Mr. T. M. AINSCOUGH, O.B.E., Senior Trade Commissioner in India, is at present in this country on an official visit, and will be in attendance at the Department of Overseas Trade during October for the purpose of interviewing manufacturers and merchants interested in trade with India. Such interviews will only be given by appointment and applications, quoting the reference 4814 T.G., should be addressed to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W. 1.

A new edition of the second volume (parts I and II) of Roscoe and Schorlemmer's work, "A Treatise on Chemistry," has just appeared, the general editor being Mr. B. MOUAT JONES, M.A., D.S.O., of the Imperial College of Science and Technology, Kensington, who has collaborated with a number of eminent contributors. This makes the sixth edition of this standard treatise, and it would appear that the high traditions of the past are still fully maintained in these new volumes. It gives an encyclopædic survey of all the important facts and theories of inorganic chemistry in a manner which is both attractive in reading and conducive to easy reference.

At the Central Preston, Oriente, Cuba, of the United Fruit Company, a plant for the production of 900,000 gallons of alcohol motor fuel is being installed, using five million gallons of molasses annually as raw material. It will supply, not only the wants of the Cuban properties of the U.F.C., but also to some extent those of their establishments in Costa Rica, Panama, and other Central American countries. In this plant (construction by the Walter E. Lummus Co.,) ether and alcohol vapours will be condensed together to give a mixture suitable for internal combustion engines, the only addition to the spirit being some aniline colouring matter and a small quantity of a chemical (not specified) to prevent rusting.

The Celite Products Company have long felt the need of establishing a common trade-mark standing for their group of products, one which might link them together, and indicate a common purpose, these several specialities being: "Sil-O-Cel" (heat insulating material; "Filter-Cel" (an aid to filtration, well known in the sugar industry); "Celcote" (for water-proofing exterior insulating surfaces, and preventing air in-filtration through boiler or surface walls); and "Fraxite" (a high temperature cement). They have now adopted a very attractive and artistic trade-mark, designed in the form of a shield; on this appears a castle wall, across which is written "Barrièrs to Industrial Waste," and below the names of the four products, and in small type the purpose which they serve.

O. RUFF[4] and others point out that a vital factor determining the activation of charcoal is the nature of the medium in which it is heated. A small amount of residual gas is retained by the charcoal in the form of a complex, and it is the chemical nature of this residue which gives the charcoal its specific property. Further, the amount of ash in the charcoal influences the development of the surface, and its nature (whether mineral matter, salts or substances acid or basic in character) also determines the nature of the activated material. One hundred grms. of coconut charcoal heated in nitrogen at 1000°C. absorbed only 1·4 grm. of phenol; whereas the same quantity of the same charcoal which had been heated in steam had as high an absorption (under the same conditions) as 38·7 grms.

[1] A description of this remarkable apparatus will be given in a later issue of this *Journal.*

[2] *Chemiker Zeitung*, 1923, No. 51/52. The spirit mentioned is being made by WINKELHAUSEN-WERKE A.-G., of Magdeburg, and a similar product is also being produced by the firm C. T. THÜNLICH, A.-G., of Wilthen i. S., Germany.

[3] *Facts about Sugar*, 1923, 16, No. 4, 104.

[4] *Kolloid-Zeitsch.*, 1923, 32, 225-232; through *J.S.C.I.*, 1923, 42, No. 29, 644A.

Review of Current Technical Literature.[1]

FACTORS TO CONSIDER IN BUYING A MILL. *Earle M. Copp.* *Facts about Sugar, 1923, 16, No. 6, 112–113.*

Cost.—In many cases the initial cost is the dominant feature; but when considering this matter the future cost of replacements, and of operation, including that of the h.p. required, the lubricating oil consumed, and the manual labour necessary, must also be studied. *Delivery.*—A long delivery with a favourable price may not mean any better bargain than a short delivery with a higher price. *Durability.*—This term here applies to stationary parts (as bedplates and housings), excluding replacements, as rolls, gearing, turnplates, turnbeams and bearings; but it is remarked that a much more important aspect is the durability of design. *Quality.*—In regard to material, one should consider the metals used for the different parts, e.g., steel or cast-iron for the gears; open or close grain, hard or soft metal for the rolls (the former affecting the gripping, and the second the life of the grooving); kind of steel for the shafts; kind of bronze for the bearings, cast-steel or other metal for the turn-beam; cast-iron or sheet-metal for the juice pan; and the kind of steel for the coupling. In regard to quality of workmanship, this of course covers the whole mill, but there are parts that require special attention, such as gear teeth, whether cast or machined, and roll shells, the manner in which they are fastened to the shaft. *Manipulation.*—Some types of mills may be fed automatically, a feature with advantages, if applicable, though it is still questionable whether such devices will work satisfactorily when the cane is not cut into short pieces, as in Cuba. Further, automatic lubricating systems are in use. Some mills have endless points of lubrication in places difficult of access, whereas others are so designed that there are comparatively few points, and these easy to reach. Then it is well to consider the eventuality of manipulating the mills in case of a choke. Stopping the engines, or throwing off intermediate carriers, is not to be recommended, since these influence the time factor, and cause the bagasse to pile up in other places; but releasing the hydraulics has its advantages in this connexion. *Labour.*—Additional men round a mill may be needed for cane feeding, lubrication, cleaning up *bagacillo*, cleaning the juice pans, watching each mill unit to prevent "chokes," and for other duties. *Time.*—That mill losing least time in the clearing of "chokes," changing hydraulic leathers, renewing carrier links, cooling bearings, and the like is the most efficient. *Replacements.*—Under this heading, one should consider what is the likelihood of a part having to be replaced, and how long will it take to do so. *Adjustments.*—Since these are always necessary, one should enquire whether the turn-plate can be adjusted while the mill is running; what operations are necessary; and how the scraper plates and the rolls can be adjusted. *Extraction.*—Provided the roll metal is hard and coarse grained, almost any mill of good design can be made to extract a maximum amount of sucrose by various means known to engineers (e.g., pressure on rolls, speed of grinding, type of crusher, amount and manner of applying maceration, setting or rolls and of turn plates, and the grooving), but none of these items, excepting the type of crusher used, depends on the mill design to any extent. *Construction.*—Lastly, a list of special points which should be examined by the purchaser when buying a mill is as follows: Minimum of friction and of frictional moving parts; easy interchange and adjustment of parts; ease of manipulation; minimum of time lost in various operations; workmanship of the crown roll teeth; single or double crown wheels; hydraulics or springs on the crushers; slope of juice pans; means of adjusting rolls and turn-plates; bearing surface of the roll shell on the shaft; angle and length of chute; accessibility of parts, especially of the lubricators; effect of crusher roll movement on scraper plate; height of gearing, crusher, and mill above ground; distance between bottom roll centres; means for the prevention of the entry of juice to the bearings and between the roll shell and shaft; and the means of adjusting the crusher rolls and of supporting the turn-beam.

ADVANTAGES GAINED BY A HIGH ADDITION OF LIME, AND EXPERIMENTS ON LIMING AT THE MILLS. *H. F. Hadfield.* *Facts about Sugar, 1922, 15, No. 24, 480-481, 488.*

In one of the Hawaiian factories the undetermined losses were so great during the early part of the season as to make it imperative to devise some change in routine capable of effecting a more satisfactory operation. These losses did not arise from mechanical causes, and it was decided that the idea of the presence of dextro-rotatory gums due to intensive milling could not be considered as the explanation of the question, though possibly these bodies do increase the estimated sugar to some extent. Inversion was assumed to be the reason of the irregularity, and it was decided to increase the lime gradually, observing the result on the control figures. More than the amount considered to be requisite for a proper clarification was used, the addition being increased till the juice became dark in colour, and decidedly alkaline; while soda ash was added to the seed till it became alkaline, to the low-grade massecuite, and also to the final molasses which was being mixed with the low-grade massecuite as a diluent. Further, juice at the re-settling tanks and the mud at the presses were always kept alkaline, as were also the sweet-waters used for maceration. A very marked improvement was soon observed, as can be seen in the following table of results, in which are shown the figures obtained at different periods during which the lime was gradually increased. Increasing the lime in this way did not change the viscosity of the low-grade massecuites; there was no foaming of the low products in the cooling tanks; no additional accumulation of scale in the evaporators occurred; and the sugar did not cake during storage. In fact, the only drawbacks seemed to be the slower boiling of the pans and the advent of *Leuconostoc*, which latter, however, was not a serious difficulty. But it is mentioned that, even in spite of the increase of the lime in this manner, it was impossible to drop an alkaline low-grade massecuite.

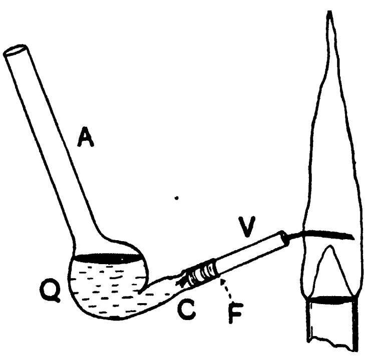
	1st Period Neutrality.	2nd Period Alkalinity.	3rd Period Alkalinity.	4th Period Alkalinity.	5th Period Alkalinity.
Lbs. lime per ton cane	1·05	1·34	1·45	1·54	1·89
Total recovery	87·67	91·846	92·158	91·235	92·6
Boiling-house recovery	89·09	93·3	93·5	92·66	94·07
Undetermined losses	4·19	0·718	0·758	1·064	0·7
First mill juice purity	87·4	88·4	87·6	86·45	87·0
Mixed juice purity	85·44	86·0	85·73	85·34	85·35
Clarified juice purity	86·0	86·3	87·4	86·66	86·5
Syrup purity	87·0	88·0	87·9	86·54	86·9
Gravity purity final molasses	35·42	36·6	36·9	37·1	38·12
Apparent purity final molasses	30·0	34·0	34·0	34 0	34·0
Per cent. ash in sugar	0·41	0·55	0·59	0·52	0·63
Per cent. in final molasses	8·04	8·62	8·3	8·39	9·05
Low grade molasses per ton cane.	0·84	0·84	0·79	0·89	0·93
Per cent. polarization in cane	12·59	12·78	12·9	13·0	12·92
Stoppages in hours	23·55	54·50	25·0	82·45	74·25

With the object of checking the loss of sugar that must always occur during milling, especially in the case of a 12-roller plant with compound maceration, milk-of-lime (at a density less than 40° Brix) was run in a thin stream into the third mill receiving tank till its contents were alkaline, this juice being pumped on the bagasse emerging from the first mill. This alkaline bagasse on passing through the second mill gave an alkaline juice, which joined the unlimed first mill juice at the mixed juice tank. Alkaline juice from the fourth mill was used for macerating the alkaline bagasse coming out of the second mill, this liquid running into the third mill receiving tank, where the stream of milk-of-lime mixed with it. Then the alkaline bagasse from the third mill was macerated with the alkaline sweet-water from the presses, and after going through the fourth mill a juice containing practically no lime was obtained. It was found more expedient to carry out the actual liming of the mixed juice at the scales, and therefore the rate of flow of the milk into the third mill receiving tank was such as to leave the mixed juice still acid. As the result of this liming process, all sliminess and acrid smell disappeared, and it would appear that the fermentation which ordinarily must occur with a long train of mills and compound maceration had thus been checked. If there is a loss during the passage from

the first to the last mill (as undoubtedly there is) it should be accounted for in the system of chemical control adopted, and the estimated sugar should be based on that polarized at the crusher, and not on the total amount received at the boiling-house *plus* that at the last mill. Since the clarified juice obtained by the use of an excess of lime in the manner described was very dark in colour, it was deemed advisable to reduce the temperature of the heater to 190° F. (88° C.), and when this was done the final colour of the juice was not unduly dark, nor the rate of settling unduly slow. These experiments, therefore, would appear to show that the orthodox fear of adding much lime is unfounded, and that by the addition of almost twice the ordinary amount a much higher recovery may be obtained.

DEVICE FOR THE PRODUCTION OF SODIUM LIGHT FOR USE WITH POLARIMETERS. *J. J. Manley.*[1] *Philosophical Magazine, 1923, 45, 336-337.*

A device is described for the production of coloured flames for use with polarimeters and spectrometers. It is stated to be extremely convenient, to require but little attention, and to make possible the production of an intense flame coloration for any desired period, the troublesome and unsatisfactory methods so frequently employed being thus entirely avoided. Its form is clearly seen in the illustration. Near one end of a glass tube *A*, about 1 cm. (⅜ in.) wide and 20 cm. (7⅞ in.) long is first blown a bulb *Q*, having a capacity of 20 or 30 c.c.; then the short length of tube below the bulb is softened, drawn out, and bent at right angles to the larger limb *A*. In forming the narrower limb, care must be taken to make the diam. such that a portion of a "vitreosil" pipe *V* having a length of 8 cm., a diam. of 5 mm., and a bore of 1 mm. can be easily inserted. A constriction at *C* prevents the pipe from entering the tube for more than about 2·5 cm. The pipe with a few fibres of asbestos coiled upon it spiral-wise is introduced into the tube with a screw-like motion, the junction *F* gently heated, and a little Faraday cement applied; a secure and liquid-tight union is thus effected. Finally, a bundle of three or four platinum wires, each 10 cm. long and 0·3 mm. in diam., is placed within the pipe as shown. This bundle of wires constitute a wick, the upper and free end of which is bent into a horizontal or even slightly downward position. On charging the bulb *Q* with the solution of sodium salt (to which should be added a very little hydrochloric acid) and placing the exposed portion of the wick within a Bunsen flame as represented in the figure, an intense coloration is produced, and this as a result of the capillary action of the wires and pipe may be indefinitely maintained. The flame may be fed at very different rates by varying the inclination of the limb *A*, a suitable inclination being readily obtained by a corresponding rotation of the supporting clamp (which is not shown in the figure). When the apparatus is not in use, *A* should be inclined so that a bubble of air appears at *C*.



PRODUCTION OF PLANTATION WHITE BY THE ADDITION OF "CARBROX" DECOLORIZING CARBON TO THE JUICE, AND THE COST OF OPERATING THE "NORIT" PROCESS. *W. H. Dunstone, Jr.* *Facts about Sugar, 1923, 16, No. 10, 190-191.*

In a certain factory in Louisiana the process of working was initiated,[2] according to which ¼ lb. of "Carbrox" carbon was added to the juice from one ton of cane, and this allowed to settle out with the mud without attempting to revivify, the theory being that a fine grade of white sugar can be obtained without any other treatment. This method of working is criticized. It is said that to those familiar with decolorizing carbons, it hardly

[1] Magdalen College, Oxford. [2] *I.S.J.*, 1922, 547.

seems possible that this small application could have the desired effect, or that so light a carbon could be subsided. This apparently proved to be the case, as the process was changed to a process of washing and remelting raws, adding the carbon at the rate of ½ lb. per 100 lbs. remelted, filtering and boiling to granulated, kieselguhr being added to assist revivification, and no attempt made to revivify the carbon, since the cake was dumped into the juice and settled out in the mud. It is assumed that in this method 25 per cent. of the original raws made are re-processed, and that 0·625 lb. of carbon and 0·5 lb. of kieselguhr are used for every 100 lbs. of raws. Also that 190 lbs. of raws are obtained per ton of cane (though an 8-year average for Louisiana was 140 lbs.). On this basis 1·1875 lb. of carbon and 0·95 lb. of kieselguhr are used per ton of cane, and if the materials cost 12·5 cents and 2·5 cents per lb. respectively, the total cost per ton of cane is 16·5 cents. Comparison is then made with figures from the cost sheet of a factory making raws, remelting, and refining by the regular "Norit" process, the carbon being revivified by reburning. In cents per ton of cane the labour used in revivification was 0·8743; the fuel oil for the kiln, 0·1530; and the "Norit" replacement, 2·70 cents, that is a total of 3·75 cents, or a difference in favour of the method involving revivification of the carbon of 12·85 cents, i.e., a ratio of 1 : 4½. If the cost of the process doing without revivification were to be cheapened so as to compete with the method involving revivification, it would mean (not counting the cost of the kieselguhr treatment) that the cost of the opposition carbon would have to be 3 cents per lb., or $60 per ton, a figure which does not appear to have been attained so far.

ACTIVATED (DECOLORIZING) CARBON, ITS EVALUATION, MANUFACTURE, AND USES. *Frederick Bennet, Jr.*[1] *Chemical Age, 1923, 31, No. 7, 327-331.*

A summary of our present knowledge of the subject. Under the heading of the technical preparation of a carbon, it is stated that this should be carried out in two stages: (1) the formation of the amorphous base; and (2) the removal of the hydrocarbons absorbed by this base so as to increase the porosity of the material, which two reactions are sometimes carried out in the same furnace. Ground material is fed into a revolving retort, slightly inclined, in a comparatively thin layer, so that contact of hydrocarbon vapours with hot carbon is avoided as far as possible, and the vapours are removed before cracking temperatures are reached. As the carbon travels down the tube, the temperature rises, and by the time the steam zone is reached the heat is at the right degree for the scouring action of the steam to become effective. Subsequent steps are to cool, grind, wash with acid and water, dry and pack.

CONTROL OF AFTER-PRODUCT WORK IN THE BEET FACTORY, USING THE FACTOR EXPRESSING THE ELEVATION OF THE BOILING POINT. *J. Dedek and J. Janousek. Zeitsch. Zuckerind. cecho-slov. Republik, 1923, 47, Nos. 40, 41, 42, 515-519, 563-569, 593-599.*

Using the "elevation of the boiling point" (*E*) in conjunction with other factors, the authors follow in detail the boiling of a number of after-product strikes in the beet factory. They explain that in order to know how far the concentration of the syrup has progressed, and in order to ascertain when fresh syrup should be drawn into the pan, the composition of the mother-syrup must be known, but as this cannot be determined by analysis with sufficient rapidity an indirect method must be applied. This consists in the application of the factor *E*, which states the difference between the boiling point of the mother-syrup and that of water under the same vacuum, and the higher the density of the mother-syrup and the lower its purity, the greater is this difference. During the course of a campaign, *E* remains constant, and therefore it suffices at the beginning of the season once and for all to establish its value at the point at which the formation and growth of grain best proceeds. This optimum value may be established empyrically by causing an experienced pan-man to bring a strike to graining point, or it may be ascertained more precisely by chemical analysis, taking samples every hour, so as to obtain

[1] Director of the Wilmington Experimental Laboratory, Atlas Powder Company, U.S.A.

definite information of every phase of the process of boiling to grain. URBAN[1] has compiled a table from which, given the purity and the temperature, the optimum value of E can be read off, though it is to be noted that these values do not always correspond with those established by an actual test. In an example given of this method of controlling boiling, 100 h.l. of green syrup were drawn into the pan, the composition of which was as follows:—Brix, 74·25, polarization, 59·50, purity, 80·15; while another test made after thickening showed: Brix 83·35, polarization, 66 90, purity, 80·26, the vacuum being 60 cm., and the temperature 73°C. As the boiling point of water under the same vacuum was 61·7, E was 11·3. It had been established that grain formation should take place with E at about 15, so the syrup was further evaporated until with the vacuum at 57–59 cm., and the temperature at 80–85°C., E was about 17. At this point 320 litres of warm water were drawn in, and boiling continued to graining point, at which point E was found to be 15·4. A very full tabulation of results controlling the boiling of after-product strikes is presented, the values stated being: time, temperature, vacuum, boiling point elevation, Brix, polarization, purity, and supersaturation coefficient.

SUGAR DUST EXPLOSIONS. *P. Beyersdorfer. Kolloid-Zeitschrift, 1923, 33, 101–107.*

Dust clouds are regarded as aero-sols, and the charge necessary for their ignition, as well as other properties associated with them, are calculated much on the same lines as in a previous paper recently reported.[2]

DENATURED ALCOHOL (IN CANADA, U.S.A., AND THE UNITED KINGDOM). *Ross E. Gilmore. Chemistry and Industry, 1923, 42, No. 34, 802–808.*

Specifications are given of the 10 grades of denatured alcohol authorized in Canada, the uses to which they are generally put, the conditions of sale imposed, and their relative consumption. Some particulars are also given of the denatured alcohol authorized in Great Britain and the United States. Also some statistics relating to the alcohol distillation industry in Canada.

THE ENGLISH SUGAR BEET CROP. *R. N. Dowling. Journal of the Ministry of Agriculture, 1923, 30, 21–27.*

This article discusses the quantity of seed necessary per acre (15 lbs. being found suitable on average soils and under average conditions); and the distance to be given between rows (16 to 18 in.); and also remarks on the value of early singling; on sugar content; attitude of farmers; principle of co-operation; and contract conditions. In 1922 the average amount of sugar in the beet was 16·5 per cent., a large number of crops having 17 and 18 per cent., and some few reaching 19 and 20 per cent.

CORN SUGAR (STARCH GLUCOSE OR DEXTROSE) MANUFACTURE. *J. K. Dale. Chemical Age, 1923, 31, No. 7, 295–296.*

An illustrated outline is presented of modern methods of production of solid starch glucose, as used in the following industries: tanning leather, caramel, vinegar, and artificial silk.

EXPERIMENTAL DATA ON PECTIN-SUGAR-ACID GELS. *R. Sucharipa.*[3] *Journal of the Association of the Official Agricultural Chemists, 1923, 7, No. 1, 57–68.*

A number of factors entering into the formation of pectin-sugar-acid gels were investigated, such as the quality of the pectin, and the time and temperature of setting, the method of preparation, and the like. Two methods are described for the comparison of the gel-forming properties of various pectins, and a device capable of serving as a "gel-tester" is described. A summary of the literature of this question is appended.

J. P. O.

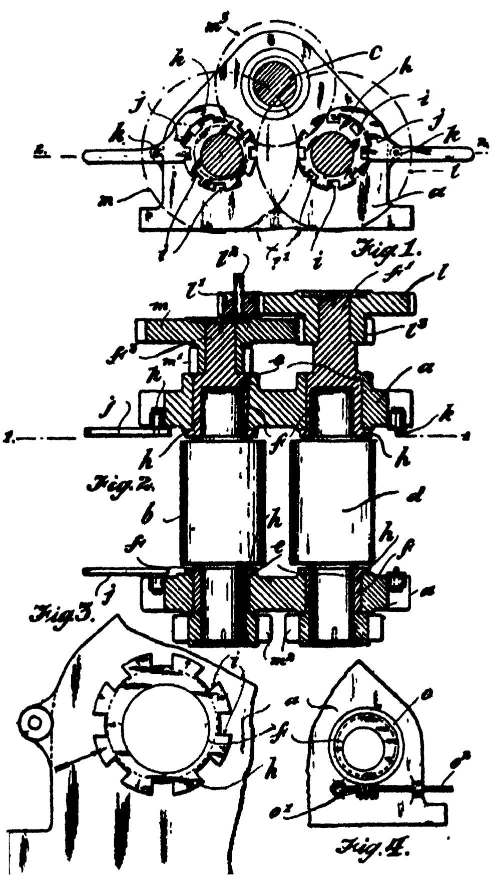
[1] *Zeitsch. Zuckerind. cecho-slov. Republik*, 1919–20, 44, 211. [2] *I.S.J.*, 1922, 573; 1923, 363.
[3] Of the Bureau of Agriculture, Prague, Czecho-Slovakia.

Review of Recent Patents.[1]

UNITED KINGDOM.

Mills having Solid Cast Headstocks. *Archibald Blair* (*of Blair, Campbell & McLean, Ltd.*, of Govan, Glasgow, Scotland); and *Richard Webster*, of the same address. *200,343.* June 24th, 1922. (Four figures; and five claims.)

Cane mills are provided with solid head stocks bored, to receive, and fitted with, adjustable eccentric bearings for the roller shafts, by means of which the space between the feed roller and the top roller, and also between the bagasse roller and the top roller can be readily adjusted. In such a construction the usual gaps in the headstocks together with their covers are entirely omitted. Referring to the drawings, *a*, *a* designates the two headstocks, *b* the feed roller, and *d* the bagasse roller, only the shaft *c* of the top roller being shown. Each headstock is cast solid and bored at *e* to take the bushes *f*, bored eccentric with respect to their outer bearing surface. Said bushes are provided with flanges *h* having a series of cuts *i* with which engage the jaws of spanners *j*. The latter are removably mounted on bolts *k* secured to the headstocks, by which arrangement the bushes *e* are normally prevented from rotating. In the bushes are journaled the shafts of the rollers *b* and *d*, the shaft *c* of the top roller being journaled in ordinary bearings fitted in holes bored in the headstocks. On one side of the mill the bushes are provided with solid extensions concentric with their outer diameter. On one of said extensions f^1 is loosely fitted a spur wheel *l* with which meshes the driving pinion l^1 on the driving shaft l^2. On the extension f^3 of the other bush is loosely fitted a spur wheel *m* which meshes with a pinion l^3 on the boss of the spur wheel *l*. A pinion m^1 formed on the boss of spur wheel *m* meshes with a spur wheel m^3 keyed to one end of the shaft of the top roller. A pinion on the other end of the latter shaft meshes with pinions m^2 keyed to the shafts of the rollers *b* and *d*.



In operation the power transmitted by the driving shaft l^1 drives through the loosely mounted driving gear at one side of the mill the top roller, and the latter through the gearing at the other side of the machine drives the rollers *b* and *d*. When it is required to adjust the rollers *b* and *d* with respect to the top roller, the bolt holding the spanner

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

wrench is removed to allow the jaws of the spanner handle being withdrawn from the gaps and the spanner wrench shifted so that the jaws can be inserted in the gaps immediately above or below. By using the spanner as a lever, the eccentric bush can be rotated and when the hole in the spanner again registers with the bolt hole, the bolt can be reinserted to lock the spanner and therefore also the eccentric bearings. Owing to the eccentricity of the bore of the bushes, the rollers journaled therein are moved towards or away from the top roller, the axes of the gear wheels l, l^3 m and m^1 remaining unaltered. As shown in Fig. 3, the flange of the bush may be provided with a number of marks or arrow-heads which may be numbered; and which, in combination with the arrow-head or other mark on the headstock, indicate the distance between the rollers. In the modified arrangement shown by Fig. 4 suitable for use in mills of larger dimensions the flanges of the eccentric bushes are provided with a worm wheel o which meshes with a worm o^1 on a shaft o^2 carried by the headstock. By rotating said shaft by means of a hand crank the eccentric bearing can be rotated to effect adjustment.

PURIFYING LIQUIDS (AND GASES) WITH ACTIVATED (DECOLORIZING) CARBON. *J. N. A. Sauer*, of Amsterdam, Holland, *198,373.* May 26th, 1923; convention date, May 26th, 1922.

Liquid (or gas) to be purified is subjected to the action of a plurality of active carbons possessing different physical and physico-chemical properties, and so chosen that they supplement one another in their action. Six types of carbon are distinguished, and they may be employed in admixture with one another or consecutively.

Type 1 comprises carbons produced from materials of vegetable origin and activated by means of gases such as superheated steam or carbon dioxide at a temperature of 800-1200° C. Included in this category are the carbons sold under the names "Norit," "Eponit," "Batchite" (from coal), and "Dorsite" (from coconut shells), the properties of which, varying somewhat according to the nature of the raw material used, are briefly referred to. *Type 2* comprises carbons produced by dry distillation at temperatures of 200-2000° C. of organic raw material such as peat, sawdust, seaweed, or pine needles admixed with, or naturally containing, inorganic materials such as alkalies or alkaline earths, lime salts, or sulphuric acid. The product is generally extracted, for example, with acids, leaving a carbon which is stated to have no pronounced structure and to be a poor filtering medium. Such carbons are those under the names "Carbrox" (from rice or cotton), "Kelpchar" (from seaweed), "Darco" (from lignite), and "Delclowyte" (from peat). *Type 3* comprises carbons produced by calcination and subsequent extraction of a solution of cellulose, molasses, or other carbon-containing materials in a suitable solvent such as concentrated zinc chloride solution, hydrofluoric acid, or sulphuric acid. A modification of the process consists in coking the raw material and extracting the residue with a substance such as selenium oxychloride which dissolves the coking products. Carbons of this type are stated to be very finely divided and unsuitable for filtration, but to be active absorbing agents. The carbons sold under the names "Carboraffin" (zinc chloride carbon), "Filtchar," "Super-filtchar," "Suchar," and "Sulphite-carbon," the last four of which are prepared from sulphite-cellulose liquors, are included in this category. *Type 4* comprises carbons produced by adding kieselguhr or other porous inorganic materials to the solution to be treated by the process giving carbons of type 3, or to starch and other carbohydrates which are then subjected to dry distillation. Such carbons are stated to be poor filtering and decolorizing agents. The carbon sold under the name "Molaschar" is referred to in this connexion. *Type 5* comprises carbons produced by dry distillation at temperatures of 400-600° C. of materials, generally of animal origin, which naturally possess the property of yielding decolorizing carbons, such as bones, blood, fish, and the residues from the removal of fusel oil from alcohol. Such carbons, after extraction, as with acids, are stated to be active absorbing agents but poor filtering media. They include ordinary bone charcoal, "Noir Epuré" (extracted bone charcoal), "Noir lavé en Pâte" (bone charcoal extracted with sulphuric or hydrochloric acid and sold as a paste containing 80 per cent. of water), blood charcoal, and the varieties sold under the names "Bactanat"

(from fish), "Flandac," "Flaming," and "Littoral." *Type 6* comprizes decolorizing carbon prepared from gases. They are stated to be very finely divided, but to be in general poor filtering and decolorizing agents. The carbon "Minchar" is instanced.

The invention is illustrated by reference to the purification of sugar solutions, glycerine, oils, and fats, the treatment of wine, and the separation of one or more constituents of a gaseous mixture. Sugar solutions are preferably pre-treated with a carbon exhibiting a definite structure, e.g., "Norit," which acts as a filtering agent, and are then treated with a finely divided carbon, such as "Carboraffin," which acts as a decolorizing agent. Wine is treated with a mixture of a carbon having good filtering properties, e.g., a carbon of type 1, and one possessing good decolorizing properties, e.g., "Noir lavé en Pâte." Glycerine is similarly treated with a mixture of "Norit" and "Carboraffin" or "Suchar." The carbons employed may be treated with substances that are capable of enhancing their effect, or of preventing undesired subsidiary reactions. For example, sodium phosphate is added to active carbon for removing iron from glucose solutions. Oils and fat containing fatty acids may be treated with a mixture of active carbons, one of which has been impregnated with lime. Gelatin may be added to the carbon used in the treatment of wine, and acid to that used in the clarification of sugar solutions. The application of the invention to the treatment of gaseous mixtures is described by reference to the removal of hydrogen sulphide and benzol from illuminating gas by the use of a mixture of two kinds of active carbon. The benzol can afterwards be recovered by treatment with superheated steam or by heat, and sulphur resulting from the oxidation of hydrogen sulphide by the oxygen in the charcoal may be recovered by means of superheated steam or removed by oxidation.

APPARATUS FOR EVAPORATING DISTILLING, HEATING OR COOLING LIQUIDS. *Blair, Campbell & McLean, Ltd., and Archibald Blair,* of Woodville Street, Glasgow, Scotland. *199,210.* May 4th, 1922. (Four figures; four claims.)

This invention has reference to apparatus for evaporating, distilling, heating or cooling liquids of the type in which the fluid to be treated is circulated through a nest of tubes enclosed within outer casings or jackets, and the heating or cooling fluid circulated through the said casings or jackets, or *vice versa*. In an improved apparatus of this type, constructed according to the present invention, each nest of tubes is enclosed within an outer casing secured to end plates, the tubes passing freely through openings in the latter and their extremities connected by suitable bent or curved connections to the tubes forming the adjacent nest, the said connections being enclosed within a suitable dome or cover secured to the end plates. The extremities of the tubes, and also those of the end connections, are conveniently secured in any appropriate manner to tube plates secured together within the said dome or cover by any convenient means. For example, the one plate may be reversed and the other adapted to fit and be secured within same by bolts and nuts, so as to form a tight joint.

MANUFACTURE OF GOLDEN SYRUP. (1) *John G. Eastick, J. C. N. Eastick, and A. G. Eastick.* *5900* of 1914. March 9th, 1914. (2) *R. Cheves and E. G. A. Saunders,* of Tongaat, Natal, B.S.A. *199,359.* April 17th, 1923.

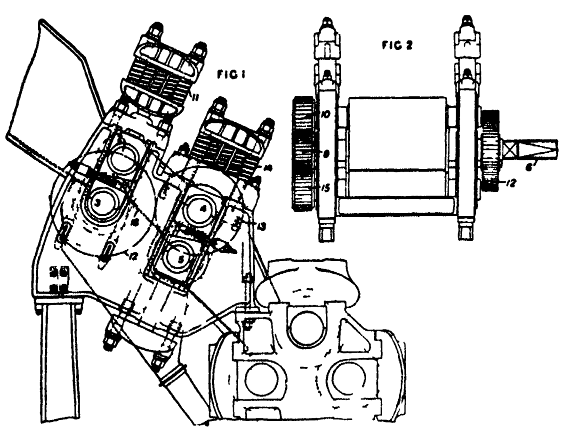
(1) In order to reduce the formation of dark coloured bodies in the manufacture of golden syrup, invert sugar, starch glucose, etc., during the time that the liquor is maintained at a high temperature, decolorizing carbon is added to the liquor at the earliest possible stage, and in such quantity (1 to 10 per cent.) that decolorization proceeds *pari passu* with inversion, and both operations are completed simultaneously. In this way, not only is time saved, but the formation of useless coloured products is avoided, whilst the acid also assists the decolorizing carbon in the removal of the colour, "as has been well known since 1838." Mixture may be effected by ordinary mechanical means, but preferably a current of air, or better of oxygen should be used, this being effective in further assisting in the removal of dark coloured bodies. After decolorization the carbon may be filtered from the solution, "and by suitable treatment prepared for use again," while the filtered solution

is neutralized, again filtered, and subsequently finished in the usual way. The process is suitable for beet sugars and syrups, when sulphuric and phosphoric acids giving a precipitate with lime are used; but when hydrochloric and similar acids forming soluble salts are employed, neutralization may take place before the carbon is filtered from the sugar liquor.

(2) In this second specification, which relates to a method of preparing golden syrup, similar to that just described, sulphur dioxide is used in place of air and oxygen for the preliminary agitating treatment. The sulphur dioxide is passed through the syrup, which is then diluted with water; and the agitation continued. Kieselguhr, phosphoric acid paste, or "phosphated charcoal" is added to assist decolorization and precipitation, the sugar inverted by means of sulphurous acid, and the liquid neutralized with milk-of-lime, filtered, and concentrated.

MULTIPLE CRUSHERS FOR CANE MILLS *Reginald G. F. Finney and George Fletcher & Co., Ltd.,* of Atlas Works, Litchurch, Derby. *197,859.* July 3rd, 1922. (Four figures; and five claims.)

In Fig. 1 is shown a side elevations of one form of the invention; and Fig. 2 a partial front view of the same. Referring to these figures, the cane is fed along a feed table, to a pre-crusher consisting of a number of pairs of rolls (two pairs in the instance shown), *2, 3, 4, 5* One only of these rolls, such as *3*, is driven by means of a tail bar *6*, this generally being mounted upon the gearing bed which in sugar plant is usually arranged separate to and parallel with the main sugar machinery comprising the feed chutes, pre-crusher, and main crushing headstocks. The cane, after it has been treated by the pre-crushing rolls *2, 3, 4, 5*, passes down a feed chute, to be acted upon by the mill of any usual type, in which the greater proportion of the juice is extracted. Roll *3*, receiving its drive from the tail bar *6*, drives the roll *2*, through spur gearing *9, 10*. The roll *2*, therefore, can move against springs *11*, or against a hydraulic ram or the like, freely outwards relatively to the roll *3*, to allow for any irregularities in the feed of cane, or any hard masses passing through between the rolls *2, 3*, and yet allow for the positive driving of the roll *2* from the roll 3. Roll *4*, of the second pair of pre-crushing rolls, is driven from the roll *3*, by spur wheels *12, 13*. This roll is rigidly mounted in bearings, but the second roll *5* of this pair can move freely relatively to the roll *4*, against springs *14*. in a similar manner as the roll *2*. This roll *5* is driven from the roll *4*, by spur wheels *15*, In the arrangement shown in Figs. 1 and 2, the rolls *2, 3*, are grooved, for which suitable cleaning scrapers may be provided, such as are shown for the lower roll at *16*. The second pair of rolls *4, 5*, however, may be of the Krajewski or figured type which, as is obvious, do not allow of the co-operation of scrapers, and therefore the feed table from these rolls is required to be a certain definite distance under the centre of the lower roll. In an arrangement in which both pairs are of the Krajewski type, the cane after passing through the first pair of rolls falls on to a feed-table or lattice to be fed between the second pair of rolls. The pre-crusher may be arranged at substantially the same level as the main mill and the broken cane fed thereto by an elevator.



UNITED STATES.

MACHINE FOR USE IN THE PRODUCTION OF CUBE SUGAR. *Charles C. Reese, Joseph T. Buzzo, and Robert S. Woodford,* of Crockett, Cal., U.S.A. *1,450,423.* April 3rd, 1923. (Nine figures; 42 claims.)

In the manufacture of cube sugar, it is generally found that a certain percentage of the lumps are slightly broken after moulding and drying, which is objectionable when a high-grade product is being assembled and packed in cartons. This invention relates to a machine specially adapted to receive and deliver the sugar to the packing machine, and at the same time to permit of the thorough inspection of the product, so that damaged cubes may be eliminated before delivery to the packing machine.

CANE CAR. *Leopold Almquist* (assignor to *American Car and Foundry Co.,* of New York, U.S.A.). *1,452,486.* April 24th, 1923. (Eleven figures; nine claims.)

The object of the invention is to provide simple, convenient, readily accessible and renewable locking latches adapted to co-operate with the outwardly swinging side gates of cane cars and similar railway rolling stock, in which cars there is provided an underframe with a side wall made up of gates suitably supported at each side above said underframe, and adapted to swing outwardly away from said underframe to permit dumping the load carried in the car at the side of the track when desired. The structure is designed particularly for use in connexion with cane cars in which the cane is loaded upon a suitable floor carried by the underframe, and is held in position by means of outwardly swinging gates, which should be readily releasable from the ends of the car so as to permit the load to fall outwardly and away from the tracks upon which the cars travel. Claim 3.—In a railway car, a side sill, a gate movable outwardly at its lower portion away from said side sill, separable brackets carried by said sill, a cam mounted in said brackets, a shaft to operate said cam, a locking member for said gate held in operative position on said cam by said brackets and co-operating guiding means on said brackets, and said locking member to guide said locking member upwardly and then inwardly into engagement with said gate.

DISTILLING APPARATUS. *Hermann Bollmann,* of Hamburg, Germany. *1,449,313.* March 20th, 1923. (Two figures; one claim.)

Claim: In a distilling apparatus the combination of a closed evaporator structure, having a boiler and a head, of vertical partitions, sub-dividing the lower portions of the boiler into a plurality of compartments, such compartments being in vapour free communication with each other at their tops, pipes connecting the bottom of each of said compartments with the next succeeding compartment, whereby the liquid is delivered from the lower part of one compartment into the upper part of the next compartment of the series, such pipes being of substantial smaller cross section than such compartments and being free from heating coils therein, and of means for separately heating the liquid in the successive compartments to successively higher temperatures.

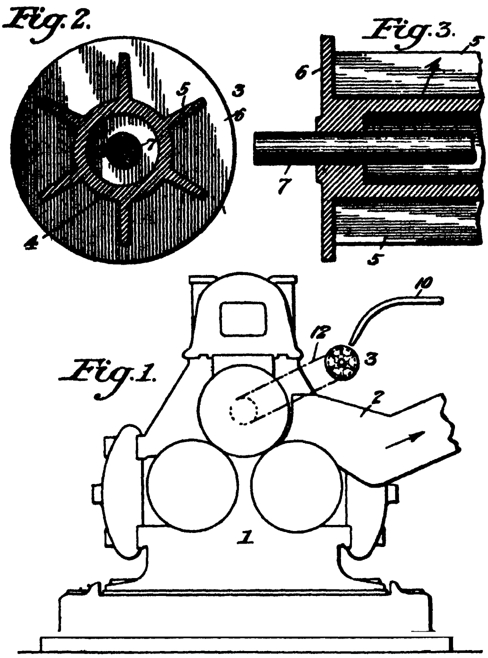
PREPARATION OF MOLASSES FOR THE MANUFACTURE OF YEAST.[1] *Alfred Wohl* (assignor to the *Fleischmann Company,* of New York, U.S.A.). *1,449,134.* March 20th, 1923. (No drawings; twenty claims.)

Claim 16: In the art of yeast manufacture, the steps in the preparation of a yeast nutrient solution which comprise preparing a moderately concentrated solution of molasses, adding thereto a mixture of mineral acid and a phosphate, heating the resultant mixture, whereby a portion of the mineral salts originally present in the molasses combine with the mixture added to the molasses to form an insoluble salt, setting phosphoric acid free in a form which is readily assimilable by yeast, and separating the precipitate from liquid.

[1] See also U.K. Patent, 169,504; *I.S.J.*, 1922, 50.

Maceration Distributor for Cane Mills. *William G. Hall*, of Honolulu, T.H. *1,461,272.* July 10th, 1923. (Three figures; four claims.)

Various devices have been proposed for distributing the maceration liquid over the bagasse, but owing to the fact that the juices from the last mills contain considerable cush cush, it has been found difficult to effect its uniform distribution. This invention is intended to obviate the necessity of straining the juices; but, nevertheless, to procure a uniform distribution of the maceration liquid and also the cush cush admixed therewith over the bagasse so as to insure a maximum extraction of the sucrose from the cane. It provides a thoroughly efficient, simple, cheap, and sanitary device for effecting this desirable object, as will be evident from the description and operation thereof which now follows. Referring to the drawings, *1* represents a typical 3-roll mill and a conveyor *2*, which leads to the succeeding mill in the series. Mounted above and transversely of the conveyor *2* is a distributing cylinder or drum *3*, which constitutes the basis of the present invention. Said drum comprises a central cylinder *4* provided with end flanges *6* and intermediate longitudinal ribs or webs *5*, which are preferably disposed radially to the axis of the cylinder and form, with the surface of the cylinder and the end flanges *6*, a series of elongated troughs or pockets, adapted to receive the admixture of maceration liquid and cush cush from supply pipe *10*. The cylinder is rotated by means of a chain and sprocket drive, such as *12*, which connects the shaft *7* of the distributor with the shaft of the top roll of the mill, as illustrated in Fig. 1. It will be noted that, as the distributing cylinder rotates above the travelling bagasse on the conveyor *2*, the macerating liquid and cush cush will be fed into the elongated trough-like elements of the distributing cylinder from the feed pipe *10*, and will be immediately spread evenly throughout the length of the receiving trough or gutter. As the cylinder continues to revolve, the cush cush laden liquid overflows the edge of the trough and is distributed in an even sheet or stream over the bagasse on the conveyor *2*. As the troughs or pockets are filled and emptied, successively, it will be apparent that a substantially uniform supply of maceration liquid will be delivered to the bagasse on the conveyor below the distributor, and the presence of cush cush will in no wise adversely affect this uniform distribution.



Rotary Filter. *John W. Bucher*, of Denver, Colorado, U.S.A. *1,465,156.* (Four claims.)

Claim 1.—In a rotary filter of the class described, a revolving supported member, a stationary valve member co-operating therewith and having an arc-shaped recess to align with the ports of said revolving member, pipes connected to opposite end of said recess intermediate the gates thereof, and means for adjusting the gate from the exterior of the valve without interrupting the motion of the filter.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending September 30th, 1922. Tons.	One Month ending September 30th, 1923. Tons.	Nine Months ending September 30th, 1922. Tons.	Nine Months ending September 30th, 1923. Tons.
Unrefined Sugars.				
Poland	....	....	....	7,996
Germany	41	....	60	1
Netherlands	....	....	....	14
Belgium	....	....	....	....
France	....	....	....	....
Czecho-Slovakia	....	....	....	....
Java	41,670	88,807	50,612	223,509
Philippine Islands	....	....	....	....
Cuba	22,642	....	626,509	250,332
Dutch Guiana	....	42	2,401	2,431
Hayti and San Domingo	....	....	....	....
Mexico	....	....	....	....
Peru	12,366	5,011	63,595	68,419
Brazil	3,148	2	63,440	77,543
Mauritius	2,801	....	107,667	131,300
British India	1,035	2,160	1,548	22,311
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	2,329	....	90,632	84,596
Other Countries	12,704	5,926	55,500	70,775
Total Raw Sugars	**98,736**	**101,949**	**1,061,962**	**939,228**
Refined Sugars.				
Germany	....	....	....	....
Netherlands	2,569	1,184	19,292	43,022
Belgium	238	150	3,234	10,621
France	569	....	589	235
Czecho-Slovakia	420	83	25,825	71,554
Java	7,508	3,960	7,959	10,114
United States of America	11,706	795	253,570	98,495
Canada	9,464	550	70,550	28,741
Other Countries	4,241	957	11,313	27,580
Total Refined Sugars	**36,715**	**7,679**	**392,333**	**290,363**
Molasses	10,534	8,512	80,422	100,573
Total Imports	**145,985**	**118,140**	**1,534,717**	**1,330,164**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
British Refined Sugars.				
Denmark	292	48	1,911	635
Netherlands	248	270	2,547	1,217
Portugal, Azores and Madeira	....	....	....	....
Channel Islands	51	115	860	749
Canada	....	....	....	....
Other Countries	922	6,044	21,168	29,959
	1,512	6,477	26,485	32,560
Foreign & Colonial Sugars.				
Refined and Candy	320	3,173	3,272	6,367
Unrefined	161	3,500	7,892	13,896
Various Mixed in Bond	....	....	....	....
Molasses	1,023	291	2,499	2,456
Total Exports	**3,016**	**13,441**	**40,148**	**55,279**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922. Tons.
Total Receipts, January 1st to September 26th	2,336,189	..	3,129,31
Deliveries ,, ,, ...	2,326,425	..	3,108,023
Meltings by Refiners ,, ,, ...	2,223,490	..	3,003,313
Exports of Refined ,, ,, ...	195,000	..	710,000
Importers' Stocks, September 26th	1,200	..	—
Total Stocks, September 26th..	110,148	..	127,752
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1920-21. Tons.		1921-22. Tons		1922-23. Tons.
Exports	1,898,821	..	3,235,393	..	2,909,624
Stocks	1,236,062	..	453,070	..	429,588
	3,134,883		3,688,463		3,339,212
Local Consumption	85,000	..	100,000	..	88,000
Receipts at Port to August 31st	3,219,883		3,788,463		3,427,212

Havana, August 31st, 1923 J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR NINE MONTHS ENDING SEPTEMBER 30TH, 1921, 1922, AND 1923.

	IMPORTS. 1921. Tons.	1922. Tons.	1923. Tons.		EXPORTS 1921. Tons.	1922. Tons.	1923. Tons.
Refined.... ..	45,225	392,333	290,363	Refined	329	3,272	6,367
Raw	83,741	1,061,962	939,228	Raw	2,266	7,892	13,896
Molasses . ..	8,213	80,422	100,573	Molasses	455	2,499	2,456
	137,179	1,534,717	1,330,164		3,050	13,663	22,719

HOME CONSUMPTION.

	1921. Tons.		1922. Tons.		1923. Tons.
Refined	353,822	..	371,710	..	292,480
Refined (in Bond) in the United Kingdom	589,917	..	714,241	..	708,426
Raw	98,818	..	122,169	..	119,082
Total of Sugar	1,042,557		1,208,120		1,119,988
Molasses..	8,740	..	6.574	..	7,169
Molasses, manufactured (in Bond) in United Kingdom .	34,222	..	38,317	..	39,449
	1,085,519		1,253,011		1,166,606

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT SEPTEMBER 30TH, 1921, 1922, AND 1923.

	1921. Tons.		1922. Tons.		1923. Tons.
Refined in Bond	35,000	..	51,550	..	48,450
Foreign Refined	47,200	..	27,250	..	14,950
,, Unrefined..	206,350	..	185,600	..	195,900
	288,550		264,400		259,300

United Kingdom Monthly Sugar Report.

Since the beginning of September we have experienced a gradually hardening and advancing market, and speculation has been conspicuous by its absence. The "bulls" having realized their account in August preferred not to participate in the rise which many consider premature. Great strength was imparted to the market by large covering orders for the nearer months from Continental countries. A firmer tone has prevailed during the whole period: September advanced steadily from 23s. to 27s. 9d., December from 22s. 9d. to 25s. 6d., relapsing later to 24/6, March from 23s. to 25s. 3d. and later to 23s. 9d., May 23s. 3d. to 25s. 9d. to 24s. The latest quotations are October 27s., December 24s. 6d., March 23s. 9d., and May 24s.

Trade in actual sugars has been in good volume and above the normal. This is not surprising in view of the fact that it is customary for traders to let their stocks run down to a minimum on a declining market. At the end of August stocks were nil and the traders were forced to take all available supplies of spot sugars at advancing prices in order to satisfy consumption. Our London refiners experienced a series of advances during the month, and to-day's quotations are No. 1 Cubes 60s. 9d. and London Granulated 57s. 7½d. duty paid, which is 3s. 6d. per cwt. higher than on the last day of August.

The U.K. refiners have bought largely during the month, and their purchases have included British West Indian 96 per cent. at 23s. 6d., White Javas from 21s. to 22s. 9d., Brown Javas 23s. to 23s. 6d., Perus 96 per cent. 22s. 6d. to 25s., and Mauritius 26s. 6d. to 30s.

Foreign refined has been in good demand, but is very scarce. All the available spot American, Canadian, and Continental Granulated were cleared at prices ranging from 53s. 6d. to 56s. 9d. No offers of American Granulated c i.f. were in the market, as the price paid in the United States did not permit of offers at anything like the parity in this country, So far there have been no offerings of American Granulated for 1924, but there was an indication of a price of 28s. 6d. for February/March, c.i.f. United Kingdom, but against European sugars this price is out of the question. Czecho-Slovakian sugars have not been offering from the Continent for new crop, but transactions have taken place in November/December and January/March, by second-hand sellers. at a price ranging from 23s. up to 25s. 6d. f.o.b. Hamburg. Ready Dutch Granulated sold during the month from 27s. 6d. to 30s. 6d. f o.b. Holland, but prices for their forward positions have generally been considerably above the prices ruling in this country for Czecho Granulated. There has been a good demand from other Continental countries, many having been constant buyers of sugar from Holland and Czecho-Slovakia at a higher parity than the United Kingdom could pay. Belgian Granulated and Crystals sold from 21s. 3d. to 24s. 3d. f.o.b. Antwerp for November/December, White Javas have been sold on the spot from 50s. to 54s., and Javas c.i.f. changed hands from 22s. 6d. to 27s. 6d. The rise in these c.i.f. Javas has been caused primarily by the enormous export demand from the United Kingdom for Continental ports.

The demand for refined sugar in America—as in this country—was very brisk, and the refiners who were short of raws at the end of August were forced to come into the market and clear all the Cubans at 4½ cents c.i.f. New York; and throughout the month, as the demand for refined became more and more insistent, the refiners had to pay up to 6 cents. The latest price done is 5⅞ cents.

The latest estimate for the American beet crop is 770,000 tons against 615,000 tons last year.

With regard to the European beet crop 1923-24 F. O. Licht's estimate is as follows:—

Germany	1,375,000	Spain	190,000
Czecho-Slovakia	950,000	Sweden	175,000
France	510,000	Denmark	114,000
Poland	450,000	Hungary	110,000
Holland	330,000	Austria	40,000
Italy	325,000	Other countries	175,000
Belgium	300,000		
Russia	300,000	Total	5,344,000

This estimate forecasts an increase in production of about 800,000 tons over last year, but is generally regarded by the majority of competent authorities as being about 250,000 tons too high. The sowings have certainly been increased by 17½ per cent., but recent reports—principally from France, Belgium, and Holland—show a very disappointing yield.

The exports from Java during September were:

28,048 tons to Europe, 170,362 tons elsewhere,

the total Java exports from April 1st to September 30th being 966,917 tons against 867,460 tons and 735,262 tons in the two previous years.

21, Mincing Lane,
London, E.C. 3,
11th October, 1923.

ARTHUR B. HODGE,
Sugar Merchants and Brokers

THE

INTERNATIONAL SUGAR JOURNAL.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 299. NOVEMBER, 1923. Vol. XXV.

Notes and Comments.

Improved Imperial Preference for British Sugar.

The Imperial Conference lately sitting in London has not yet issued any final report of decisions come to, but early in October the Home Government set forth for its consideration a moderate scheme of preferences which was considered by them the maximum they could concede under the present fiscal restrictions to which they hold the country is tied by the promises made at the General Elections of a year ago. These relate to classes of imports that already are liable to a duty on entry into this country, viz., dried fruits, sugar, and tobacco. The most important concession is the one in which our readers are most concerned, that given to sugar. At present, as the President of the Board of Trade pointed out to the Imperial Economic Conference, sugar is dutiable according to a scale dependent on the polarization, with a basic rate of 25s. 8d. per cwt. on fully refined sugar. Empire sugar enjoys a preference of one-sixth, or 4s. 3½d. per cwt., being nearly one halfpenny per lb. on refined sugar. It is not possible at present to offer an increase in this preference, but the Government are ready to guarantee, that if the duty is reduced, the preference shall, for a period of ten years, not fall with it, but be maintained at its present rate of nearly one halfpenny per lb., so long at least as the duty on foreign sugar does not fall below that level. This concession goes a considerable way to meeting the demands of the British overseas sugar interests that the preference should be stabilized at a fixed sum rather than be subject to pro rata reductions every time the sugar duties are reduced in the future, and they are welcomed on all hands by the spokesmen of those interests, who consider that they will restore confidence to the British sugar industry, and put new life and new capital into it. Although the monetary value of the preference is not increased, it must not be forgotten that our sugar duties, which stand at 2¾d. per lb. (refined value), have long been crying for a reduction in the interests of the consumer, and if, as seems not unlikely, the next Budget provides for some such alleviation, it will by leaving the preference at one halfpenny increase the latter's rate as a percentage. Thus if ¾d. per lb. were taken off the duty, the preference would be about 25 per cent., and if the duty is some day reduced to 1½d. per lb. the preference would amount to some 33⅓ per cent. or the maximum

rate which the partizans of the British sugar industry themselves suggested. It will be seen then that this concession to Imperial sugar on the part of the Government is not only valuable at its present "quotation" but has distinctive possibilities of considerable appreciation in the not distant future. Empire production of sugar should certainly receive a fillip, and capitalists will, it is hoped, no longer hesitate to provide the means of extending the industry.

The Government's Larger Policy.

With the sole exception of the sugar preference, the proposals made by the Government to the Imperial Conference are a very small beginning and were they the limit of concessions to be looked forward to as a result of this Conference, the result would be profoundly disappointing. But, as we remarked above, they were proposals made within the restricted limits of our present fiscal system. And since they were announced, the Government through the Prime Minister, Mr. STANLEY BALDWIN, has taken the momentous step of deciding in favour of an abandonment of our cut-and-dried free trade system, believing that the time has arrived for adopting other means to restore our trade and relieve the very serious state of unemployment amongst the working classes in this country. In a series of speeches made in the country during the last three weeks, Mr. BALDWIN has laid it down that neither our employers nor our working men should any longer be unfairly exposed to the merciless attacks of foreign competitors, who are able to shield themselves behind the walls of their own high tariffs; that although late in the day we should do our utmost to check that one-sided development of our industries, which has drawn millions of people from the land and upset the healthy proportions which ought to exist between the urban and rural populations; and that among the masses of our population, wherever they are situated, every effort should be made to save the standard of life from being reduced. With an aim to remedy these implied evils, Mr. BALDWIN lays down a number of proposals which it is the intended policy of his Government to carry out, providing the country give him their renewed confidence: To put a tax on imported manufactured goods with special regard for those imports that cause the greatest amount of unemployment amongst our people; to give a substantial preference to our Dominions; to put no tax on wheat or meat; to have investigated most carefully the best way we can help agriculture and maintain the tillage of the nation; to examine, and co-ordinate, and improve existing schemes of insurance against those evils that affect the life and health of our people, such as old age, ill health and unemployment; and lastly, to develop our own estates—our Empire.

We give this succinct summary of Mr. Baldwin's new policy in full because though some of the proposals appear to relate solely to home domestic questions, they all co-ordinate into one reasoned policy which, paraphrasing his last sentence, is to develop our Home, and our Overseas estates; and that largely by methods which are employed by practically every other nation of the world, the imposition of tariffs on imports with distinctions *in favour* of reciprocating countries and *against* those whose methods of manufacture and export to this country are a menace to the well-being of analogous industries domiciled within this kingdom. This new policy is of course such a reversal of the country's hitherto prevailing doctrine of free trade and *laissez faire* that it is not to be supposed that it can be carried into effect without an appeal to the electorate, especially as the present Government was put in power on the implied understanding that no fundamental change in our fiscal system was being authorized. But the country is no longer

in a mood to be rent by the parrot cries of doctrinaire theorists such as were so successful in staving off the last attempt at tariff reform twenty years ago. There is an important difference between then and now, which is that in those days the danger to our trade was not so apparent, trade being in fact quite prosperous and employment good, whereas nowadays the reverse is the case, trade being extremely bad and unemployment calamitous. The country is hence prepared to consider in a reasonable spirit any detailed proposals that the Government may make for solving its troubles, and to welcome them or the reverse on their strict merits.

The Government have of course still to formulate details. Mr. BALDWIN has wisely stuck so far to general principles, and these have received favourable comment outside the ranks of doctrinaire politicians and that section of the Labour party that pins its faith to a capital levy as the sole cure for prevailing ills. The decision not to tax wheat or meat rules out a very important section of Imperial preference and suggests that resort will be had to some form of bounty or subsidy to aid home agriculture—an admittedly artificial expedient but probably the lesser of two evils, since it is not practical politics in this country to start experimenting in tariff reform at the expense, real or imaginary, of the people's principal items of food. Were it feasible to carry out the projected reforms without a preliminary appeal to the electorate, it might be possible to prove speedily that a scientific tariff would not necessarily raise the price of food : but as the consent of the electorate has to be asked first, it is a good policy to remove from the turmoil of election cries that most effective one that food will cost you more.

So for a start at any rate, other means than tariffs must be adopted for encouraging Empire production of food. Sugar producers are fortunate in being an exception to the rule, their case having been decided on the strength of war-time conditions that were too patent to be ignored, and of post-war prices that were too excessive not to teach a lesson.

Imperial Preference: The British Engineers' Point of View.

The British Engineers' Association not long since sent to the President of the Board of Trade an important memorandum setting forth the views of the engineering industry in this country on the subject of the Imperial Economic Conference now sitting in London. In view of the Government's new policy outlined above, it is worth while our reproducing the views of at least one great body of manufacturers who think a change in our fiscal system is now called for.

They state at the outset that they refrain from offering a mass of statistics, pre-war and post-war, such as the Board of Trade can themselves much better collect. They confine themselves to dealing with the broad principles of the subject as it affects their industry, and avoid the political and sentimental aspects of the subject.

At the outset, however, they discuss the logic of current economic belief, and question the wisdom of clinging to past views as though these represented unchanging laws. In their opinion "it is unconducive to clear constructive thinking to dwell too much on a past combination of political and economic conditions which, in the very nature of things, cannot be reconstituted. Life is essentially change and movement; and to-day we are living in a new political and economic world, for survival in which radical readjustments are necessary."

"Owing partly to the sheer inertia of economic doctrine many so-called principles and laws, evolved from the study of the conditions of one hundred years ago, are still accepted by the vast majority as being axiomatic and are solemnly applied to the entirely different conditions of to-day. Some of these so-called laws are pernicious fallacies. It is not unreasonable to believe that their having

outlived whatever appositeness they may at some time have possessed is attributable in a great measure to the greater command and use of publicity by the wealth handler as compared with the wealth producer. Hitherto the financier, the banker, the cosmopolitan trader, and the ship-owner have been far more vocal than the farmer, the coal and mineral miner, the iron and steel manufacturer, the engineer and all the other manufacturers. The state of affairs is, however, now undergoing a rapid change for the better, the effects of which will inevitably make a deep impression on the trade policy of this country, and ultimately of the Empire if it can be held together until a sane pro-British and inter-Imperial trade policy is put into execution."

The Memorandum then goes on to cite an instance of a pernicious fallacy. We have not space to quote it in full; but, briefly put, it is the old one that goods must directly or indirectly pay for goods, and that it is not necessary to strive for direct trade between two given centres since the goods must in any case come back by a roundabout way if not direct. But the Memorandum points out that this argument ignores the very different *qualities* of the various industries and trades as measured by their effects on the standard of life and the moral qualities of the people engaged in them; it makes no distinction between skilled and unskilled and desirable or undesirable occupations. As an extreme case, we might under this "law" find ourselves in the position of paying for locomotives, turbo-generators and scientific instruments with pig-iron, rails, slop clothing and the cheapest classes of pottery ware. Such international exchanges might possibly help to enrich a few individuals, but they could not possibly be profitable to the nation, and if they were indulged in on a large scale they would soon impoverish this country and depress the standard of living of our people.

To obviate this, it is necessary that our skilled industries should receive some form or other of encouragement and that suitable markets should be found and maintained. In the case of the engineering industry and its allied trades in this country, they are suffering intensely from lack of active home and export markets commensurate with their productive capacity when working on an economic load factor. As compared with 1913 our machinery exports were only some 64 per cent. during the first six months of this year (58·8 in 1922), while the average price now is 121 per cent. above the corresponding figure for 1913. This low output makes it impossible to produce cheaply, while this is just the time when a drop in the selling prices is needed to stimulate the markets into activity. The unemployment which results from this reduced output not only causes a deterioration of the skill of the workmen but also leads to the emigration overseas of skilled mechanics; the loss will be felt when the engineering trades revive.

In these circumstances the Engineers' Association deems it necessary that everything should be done to preserve and develop the old and to open up new markets for the produce of our engineering industries. We should use to the uttermost every advantage we possess; we shall need them all. So far as our export trade is concerned the greatest of all our advantages lies in the relationship between this Mother Country and our Empire overseas, where in the main business is conducted in our own language and our goods and methods are well known and appreciated. For these reasons the Association is strongly in favour of effective Imperial Preference being extended to British manufacturers. By this they mean a Preference that will not only give us an advantage in normal competition, but also protect us from grossly unfair competition due to abnormal economically unsound conditions in any other manufacturing and exporting country.

White Sugar Manufacture by Carbonatation in Natal.

Information on the question of the manufacture of plantation white sugar is always in demand by readers of this *Journal*, and in this number we are publishing the first part of a contribution on the case for the carbonatation process (as compared with sulphitation) from the pen of Dr. FRANCIS MAXWELL, an acknowledged authority on the subject. Dr. MAXWELL some time ago assisted in the erection and subsequent operation of a modern double carbonatation factory in Java; and since the war (during which he was a civilian prisoner of war in Germany) he has travelled extensively through India, Java, Australia, Mauritius, Natal, and Zululand, studying the latest progress made in the cane sugar industry of those countries. He was appointed by all the Zululand Sugar Milling Companies as their technical adviser at the Government Conference held at Durban in October, 1922, and when in South Africa at that time he had the opportunity of closely studying on the spot the problem of the application of the carbonatation process to Uba cane juices. He is therefore very amply equipped with both knowledge and experience to discuss the question under treatment.

Dr. MAXWELL points out in the first part of his contribution appearing in this number the many difficulties attached to the sulphitation in applying it in Natal and Zululand to the Uba cane juice with its very troublesome content of "gums." On the other hand, he shows that this peculiarly refractory juice is quite amenable to treatment by the more intense clarification afforded by the carbonatation process, and that it thereby furnishes a quality of sugar intermediate between sulphitation mill whites and bonechar refined. Further, he draws attention to the fact that, according to DE HAAN, who has made a close study of the carbonatation process in Java from its various aspects, the yield of sugar is higher with this method of working than with sulphitation, which advantage may be expected to be more marked when the comparison is applied to the intractable Uba cane juice. So far, so good. But the all-important matter is the working costs (in respect of limestone, coke, sulphur, and cloth) and the capital outlay involved, which items are known to be lower in the case of sulphitation. Dr. MAXWELL takes up this commercial aspect of the question in our next number, and his data weighing the advantages and disadvantages of the two processes from the economical point of view are certain to be read with much interest.

The Agricultural Position in Natal.

Simultaneously with this paper by Dr. MAXWELL on an important manufacturing problem in Natal, we are able to publish a succinct resumé of the agricultural position of the Natal sugar industry, as revealed by the papers read and the discussions ensuing at a Congress of the sugar interests at Durban last April. The crying need of the cane growers of South Africa is undoubtedly a sugar experiment station whose trained staff could investigate the state of affairs in the canefields, study the pests and diseases with a view to their more or less thorough elimination, and, perhaps most important of all, conduct a sustained search for new varieties of canes that will prove all round superior to the standard cane, the Uba. This need of such a station was clearly admitted on all hands at the Congress, but it was hoped that the Government would be induced to lead the way financially. The latest information suggests that the Government have declined to assist, so it is left to the growers and millers to come to some amicable agreement to contribute so much a ton of cane and of sugar to a fund wherewith the experiment station could be founded and maintained. It seems hard to believe that the two parties will be unable to agree in this matter, when the need is so manifestly

urgent. The fact that the South African sugar industry is now reaching a degree of output that will exceed local requirements and necessitate a regular export surplus is a consideration that should induce all parties concerned with that sugar production not to lag behind other sugar countries in the scientific adjuncts to this important industry. We need only remind them that two of the most successful experiment station systems in the sugar world, viz., those of Java and of Hawaii, are run solely by the planters' associations without any Government assistance whatever.

Seedling Work in Barbados.

We have received a copy of the Proceedings of the Agricultural Society of Barbados at a meeting on July 27th last, printed in a local newspaper which contains a somewhat remarkable paper by Mr. J. R. BOVELL, the Director of Agriculture in the island. In it he complains at the niggardly way in which the Department has been treated for many years past by the Government, especially with regard to the placing at its disposal of suitable land on which to carry out the experiments on seedling canes, for which the island has become famous. We have noted in many of the Annual Reports issued during recent years how extremely unsatisfactory a number of the experiments have been, often leading to discordant results "from which no conclusions can be drawn," or entirely rejected because of the great destruction of cane plants by one or another of the insect pests which seem to infest the experimental plots on the station. If this state of affairs is, as is claimed, owing to the neglect on the part of the Government to give ear to the appeals of the Director of Agriculture, a very serious charge is formulated, and it is high time that something is done in the matter.

Mr. BOVELL produces a mass of figures to show the benefits which the island has in the past reaped from the production of new seedling canes of value. Practically all the sugar cane growing countries of the world have been supplied with various Barbados cane seedlings, and many have greatly benefited by those introduced, but this wider usefulness of the Barbados work is not developed in the paper presented to the meeting. The actual monetary advantage, which the Barbados planters have received from the planting of two seedlings produced by the station, is set out in great detail, and the writer arrives at the astonishing result that, during the eight years ending with December, 1922, this direct gain exceeds £4,000,000. The argument leading to this result assumes that the White Transparent or Cristalina variety, which is largely grown as the "standard," would have been grown almost exclusively in Barbados, if the two new seedlings had not largely supplanted it. We are not in a position to judge of the full validity of this assumption, but it seems to have had the full support of the body of planters present. And, in any case, there can be no doubt whatever that the success of the sugar industry of the island is largely due to the devoted work of its Agricultural Department, so we trust that the arresting figures produced by the Director will immediately result in the Experiment Station being placed in the best possible position for its work to be carried out efficiently.

Our Continental Correspondent discussing the outlook for the European beet crop for this Autumn states that the cold Spring had the effect of retarding the germination and development of the young beet plants on the Continent, while in July a hot wave for about a fortnight had the effect of promoting a stimulating growth of the stems, resulting in an unusual percentage of "shooters." September and October were too moist and too cold, causing the sugar content to remain deficient. Finally the soaked land and impassible roads now hinder pulling and transport of the roots, thus making the position still worse. So in Western and Northern Europe at any rate the crop will be deficient, and a reduction of some 500,000 tons in the total as compared with earlier estimates seems now likely (see page 615 for details).

Fifty Years Ago.

From the "Sugar Cane," November, 1873.

An article headed "An Advance in Sugar-making" announced that Messrs. Tooth & Cran of the Yengari Refinery, Queensland, had patented a process by which it was claimed the incipient fermentation of cane juice as it left the mill could be checked, enabling it to be conveyed long distances by tank or pipe-line, and by which, further, all the crop could be turned out in the form of "a pure white sparkling sugar." This process in all probability was that protected by ROBERT TOOTH,[1] his claim being as follows: "The treatment of the juice of the sugar-cane so as to preserve it from decomposition, or so as to purify it; and the manufacture of sugar from cane juice so treated by the addition of carbonic acid gas to the juice which has been treated with lime so as only to carbonate about two-thirds of the lime, thereby causing the residue of the lime to form with the sugar the compound known as tri-sucrate of lime." On receipt of the juice at the factory, it was carbonated, filtered, passed through animal charcoal, evaporated, and boiled.

A translation of an article by H. LANDOLT (the author of the well-known book on "Optical Rotation") was reproduced, and it is of some interest to draw attention to the results of his experiments on the determination of the ash of beet sugars, using the direct method, which at the present time is being advocated as preferable to incineration with the addition of sulphuric acid. Using the weakest possible flame, raw beet sugars were incinerated (this operation taking 35 min.), after which while maintaining the same temperature heating was continued, the platinum dish and its contents being weighed at intervals of about a quarter of an hour. A gradual diminution of the weight of the ash was observed, and it was concluded that "the volatilization of equal quantities of salts is proportional to the duration of the heating, and that this loss is more considerable the greater is the mass of the salts." From the results thus obtained, a table is given showing the loss suffered by different quantities of ash in this way. Thus, in the case of a residue weighing 0·08 grm. the loss by heating for half an hour was 0·005 grm., and double this quantity in an hour. LANDOLT advised that a correction should always be made in operating direct incineration, the total time of heating following carbonization being noted, and the appropriate addition made to the residue of ash obtained.

Dr. W. L. CLASEN published an article dealing with "The Action of Water and Various Neutral Salts on Solutions of Cane Sugar," and the conclusions which were arrived at as the result of a series of experiments were briefly as follows: That cane sugar in solution in pure water (37-40 grms. per 100 c.c.) is gradually inverted as the result of heating to 88°C. (the polarization of a solution thus treated having diminished from 39·9 to 37·6° V. after 3 hours), that some salts (e.g., calcium sulphate, ammonium chloride, and potassium nitrate) hinder the formation of glucose under the conditions just stated, while others (e.g., magnesium sulphate), though they do not entirely prevent inversion, appear to inhibit it to some extent less.

An article on the manufacture of sugar from the beet by E. F. CULL, of the Canada Co., of Toronto, appeared in this issue. Diffusion was not advised for the extraction of the juice, the roots being rasped and pressed; carbonatation was the method used for clarification, though the apparatus described was of a very elementary type; while two crops of sugar were crystallized, the molasses being finally treated by the osmose process.

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[1] Queensland Patent, No. 183 of 1877.

The Agricultural Position in Natal.

As compared with that of other countries, the literature dealing with the agricultural practice in the South African cane fields is not very abundant, and, since the publication of the findings of the Sugar Enquiry Commission a year ago,[1] we have not come across much information of a reliable character. But we have recently studied a copy of the *South African Sugar Journal* "Congress number" of June last, in which a series of papers dealing with the work on the plantations and in the mills has been printed. These papers were read at the first general Congress of the sugar interests in the Union, at Durban in April last, and we have read them with the greatest interest. It is obvious that the work of the Commission, not only in their published report but also in the exhaustive enquiries made preceding its preparation, has acted as an efficient stimulus to both planters and millers, so that it becomes somewhat difficult to adjust one's mind to the great change in the outlook which has taken place in so short a time. Hitherto, papers dealing with the industry written by scientific men have been few and far between, and have varied somewhat considerably in scope and quality; but one of the great surprises of the Congress has been the production of a number of such papers of a really high order. None of the scientific experts who read these papers during the "Sugar Week" appear to belong exclusively to the sugar industry. But we think that this is one of the most telling arguments in favour of the employment of a staff of specialists for the sugar cane itself, when we bear in mind the necessary limitations of the writers as regards a detailed internal acquaintance with the subject. Such a staff could devote its whole attention to the local problems; the amount of work awaiting them is as obvious as it is alarming, and the sooner they are recruited the better chance the industry will have of maintaining its position. The nucleus of such a staff would of course be an experimental station, and this proposition occupied a great deal of attention on the part of the delegates; here alone would it be possible for them to work out their ideas and make the necessary scientific comparisons on which improvement could be based.

The need for such a station, or more probably series of stations, was fully recognised by the planters and millers in council, and the urgency of this need may be gauged by remarks let fall in the discussions after the papers were read, and especially in those noted below, taken from the Proceedings of the Annual General Meeting of the Sugar Association of South Africa, appropriately held at the close of the Congress week. The Secretary's report, which was passed by the meeting, contains the following:—"Every day that passes enforces the necessity of such a station if our sugar industry is to hold its own, now that the surplus stage has been definitely reached." He then remarks that the necessity of competing in the world's markets "completely alters the complexion of affairs for us . . . . . for two outstanding facts must be faced, namely, that reliance on the Uba cane is a handicap of from 15 to 20 per cent., and that the average cultivation given is not sufficient to maintain it at the standard to be reasonably profitable." He further suggests that "if the members of the Association to-day unanimously agree to a levy of 6d. per ton of cane and millers to a levy of 5s. per ton of sugar, an almost immediate start could be made with the foundation of a station, and next season it would be in full work, preparing the way for increasing the output by 15 per cent. without any addition to cost; probably indeed at a less cost per ton of cane crushed." The chairman, in moving the adoption of the

[1] *I.S.J.*, 1922, pp. 450 and 456-461.

report, remarked that no two opinions existed as to the absolute necessity for the experimental station "if the industry is to continue to thrive, and it is obvious that further delay will be not only dangerous but suicidal." With these considered and unanimous opinions of the planters and millers in April last, we may conclude that the Natal sugar work is entering on a new phase of development. It is moreover obvious that the industry is in an extremely critical position, and, as the matter of urgency was so fully agreed on six months ago, we begin to wonder when the desired end will be attained. Of course many things have to be considered in so momentous a matter, and there are likely to be minor disagreements as to details; but we trust that these will soon be smoothed away, and that the Natal sugar news will in future be of a more concrete and interesting nature.

The opening address of the chairman, Mr. DAVID FOWLER, was mainly historical and descriptive of the past and present position of the sugar industry in Natal. He concluded with a strong appeal to all sections to sink their differences and work together for the common good. To this appeal the representatives of both planters and millers immediately responded, observing that most of their differences would probably, on examination, prove to be founded on misconception, through not knowing one another sufficiently well; and one of the most pleasing features of the discussions at the end of the various papers was the loyal way in which the different speakers maintained this attitude.

The list of papers read at the Congress covers a very wide field. The chief subjects dealt with were :—The foundation of an experiment station in Natal, and the work done in some of the more important stations in other sugar cane countries; sucrose losses in the Uba cane; cane by-products and their manurial value; the effect of humidity, fungi and bacteria on stored sugar; planters' practice in heavy land in Natal and in the flats of Zululand; manuring of sugar cane land; prospective irrigation of cane in Natal; diseases and pests of the sugar cane fields; the uses of statistics in the planting industry; and the problems connected with labour rations, transport, lubrication, and stainless steel.

The papers may be broadly divided into two classes, the ideal and the real; the former, largely the production of the experts, dealing with possibilities, and the latter, principally by workers on the spot, giving a glimpse of the actual state of affairs in the country. And in this matter the discussions after the papers were speciallly instructive, as emphasizing the practical difficulties met with by the planters and, to a less extent, by the millers. It must of course be remembered that, in an Assembly of this kind, the readers of the papers and the leaders in the discussions would naturally be drawn from the more prominent and versatile members, and that the rank and file of the cane growers (and perhaps the millers) who had found things most difficult would not be much in evidence. In this matter it is possible that the meeting was one-sided, as to the real state of affairs in the industry, but certain broad conclusions may be justifiably drawn from the general trend of the evidence presented before the delegates. A fuller state of knowledge can only be obtained on the spot, by a faithfully carried out system of touring by a series of travelling experts such as they have in Queensland. For this fuller knowledge we shall have to wait until the proposed experiment station staff has been at work for some time.

It is generally allowed that the prospects are that Natal and Zululand will, for the future, usually produce more sugar than is needed for consumption in the Union of South Africa. This being the case, export competition will have to be faced, and it is recognized that a general overhauling of all branches of work, both in factory and on the plantations, is very desirable, in order to reduce the costs of sugar production.

The following appear to be the chief points with regard to the latter, the main interest of course centering in the opinions as to the characters of the predominant Uba cane. This much criticized variety is stated to show no signs of deterioration in itself at present and, in cases where this has been detected, it is asserted that this is more likely to be owing to the treatment which it has received than to any inherent failing. The decreasing sucrose content in the Zululand fields, of which the growers profess themselves unable to judge, is explained quite simply by the natural increase in ratoon crops over those from plant canes, and among the ratoons by the greater age of the fields. Where special care has been taken in the selection of planting material, actual improvement has been observed. And the best source for this material is considered to be plant canes of 10 to 12 months growth, failing which ratoon crops of good character of no great age may be used. Several of the older planters are emphatic in their declaration that the Uba is now is a very superior cane to what it was when they first handled it many years ago. This is specially interesting when we consider what much better sugar results are obtained from it in Natal than in other countries where it is grown.

This laudation of the Uba cane receives strong support from the observation of the newly arrived State mycologist, Mr. H. H. STOREY, that all of the other varieties of cane grown in the country are riddled with mosaic disease, to which as is well known the Uba is immune. Considering the urgent need of at least a second string, the suggestion of this specialist is that all the other varieties should be dug out, and that steps should at once be undertaken to import fresh healthy seed, under strict quarantine observation. There can be no doubt as to the soundness of this advice, although of course it will not be palatable to those progressive planters who have been led to build their hopes on such new kinds as the "Agaul" and the "Argentine" canes, which latter presumably are Java crosses chiefly with north Indian varieties. But this procedure cannot be adopted without the erection of a proper quarantine station and the enlistment of a fully qualified staff to supervise it, consisting of a permanent mycologist and entomologist, which means the immediate foundation of an experiment station. It is stated that 99·5 per cent. of the whole sugar cane area in the colony is under the Uba variety, so that the actual cost to the industry as a whole of this drastic remedy would be negligible, proper compensation being paid to those destroying their canes. The precaution would of course have to be taken of a full examination of the grass weeds in the cane fields, to see that there is no chance of the re-infection through them of the new varieties introduced. The means suggested by the mycologist are, it is true, unusual, but so are the conditions of the cane fields in Natal, and there appears to be no inherent difficulty in carrying out the plan. The opinion in favour of the immediate foundation of a thoroughly up-to-date experiment station for the sugar industry appears to have been unanimous, as expressed in the papers read and in the discussions following thereon.

A clear light is thrown upon the inherent differences in the conditions of cane growth in Natal and Zululand, in temperature, rainfall and soil moisture and richness; also, in the latter country, in the growth of cane and the richness of juice in the hill country and the fertile alluvial flats. It is becoming more and more obvious that the Uba variety is less suited to this latter section in Zululand than elsewhere in the colony, and this opens anew the question whether a better class cane, with self shedding of its leaves, would not be more successful in the production of sugar, which after all is the main purpose of the industry. The chief difficulty is of course the rate of payment for cane and the regulations on

which it is based: that anomaly will presumably be altered at no distant period. But the principal need in the cultivation in the flats country is the evolution and general adoption of a rational system of drainage, which will be sufficiently elastic to be adaptable to the varying local differences in height and flatness of the land. Under the conditions so graphically depicted by Mr. PICCIONE it is safe to say that no other cane but Uba could exist without the invasion of serious fungoid disease; and it is not altogether improbable that such disease already exists and may be a contributory cause, together with the undue prolongation of ratooning, to the decreasing purity of the juice which the millers allege is taking place. A thorough investigation of this fertile tract is one of the first and most obvious duties of the proposed specialists, and the report of a fully qualified man would probably form very interesting reading. Steps should of course be taken at the earliest possible moment to enable the planters to know the character of the juice of the canes that they grow, and the differences in richness of that of plant canes and ratoons as well as of early and late ratoons. It is idle to hope for any improvement in the matter until this fundamental need is fully satisfied and, as it is more in the interests of the millers than the planters that such should be the case, it seems rather remarkable that the statements of Mr. PICCIONE should have passed without further remark.

There are other points of interest in the sheaf of papers printed in the Congress number. The question of irrigation, for instance, so well put by the Irrigation Expert, Mr. G. T. RITCHIE, is by no means to be passed lightly by. To an outsider, the position of parts of the cane area present no insuperable difficulties to its introduction; while the general lie of the cane tract appears to be ideal for a gravitation system. The details of the climate which we gather here and there show that one of the great deficiencies in the natural conditions of Natal is exactly this, the lack of water. We would refer such of the Natal planters as read these remarks to the details of irrigation in the cane fields of Hawaii, somewhat fully treated in recent numbers of this Journal,[1] in order that they may appreciate what much greater difficulties have been successfully overcome than are ever likely to be met with in their own country.

There is not space to deal with the important question of burning the fields before reaping the cane. Suffice it to say that the general opinion in Natal appears to be that this practice is little short of suicidal, when considered in connexion with soil fertility; whereas, in Zululand, it is universal because of the shortage of labour. Whether this position is valid can only be determined by the detailed study of the local conditions which we have pointed out as being so necessary for this tract.

C. A. B.

According to the *Times*, West Indian Chambers of Commerce have decided to abandon the idea of making further representations to the Canadian Government with regard to the dumping clause and the No. 16 Dutch standard as the test for sugar under the Canada-West Indies Trade Agreement, it having been shown, with regard to the former, that every protection is offered to West Indian sugar entering Canadian refineries against competition from the American article. In regard to the No. 16 Dutch standard, it is felt that this is not the time to reopen the matter with the Canadian authorities.

Messrs. Willett & Gray, in issuing their first estimates of the 1923-24 sugar crops of the world, indicate the total production of both cane and beet for the coming season as 19,145,500 long tons, against 17,947,528 tons in 1922-23, or an increase of 1,197,972 tons. The greater part of this increase is accounted for by the European beet crop and by the United States duty-protected crops of beet and cane. The new world's crop if it attains to the above estimated dimensions will be the largest on record, the previous greatest having been in 1914-15, when 18,483,432 tons was produced.

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[1] *I.S.J.*, 1923, pp. 401-408 and 455-461.

The Case for the Carbonatation Process in the Manufacture of White Sugars.

With Particular Reference to South Africa.

By FRANCIS MAXWELL, D.Sc., M.I.Mech.E., F.C.S.

INTRODUCTION.

The sugar market in South Africa is, in a sense, a peculiar one, inasmuch as the valuation of sugars is based essentially on their colour and lustre; thus, in other words, it is largely a matter of æsthetics. In view of the sugars universally made in Natal and Zululand being of the superior white kind (either "first refined" or "mill whites"), it is evident that such a standard of valuation implies the necessity of a stable uniformity of quality of these sugars. The only sugar in that country that attains a definite fixed quality is "first refined," which commands the highest price of any sugar, and constitutes the basis for the payment of cane. As regards the sugars which are not refined, but pass into consumption direct from the mills,[1] so far from approximating to a uniformity of quality, these sugars vary widely and considerably, as is demonstrated by the range of samples in a sugar broker's office. In fact, it occurs not infrequently that one and the same factory produces sugars of varying quality during a season.

Experience and observation tend to show that the variability of the quality of the cane crushed (the reasons for which cannot be entered into here), and the peculiar nature of the Uba juice, are most important factors in influencing the quality as well as the uniformity of the sugars produced. Now, the manufacture of "mill whites" in Natal and Zululand is generally carried out by the sulpho-defecation process, either with or without modification of the standard method. It would appear that this process of clarification, broadly speaking, does not afford a sufficiently intensive and energetic treatment of the Uba juice; in consequence, the deficient precipitation of the noxious ingredients must necessarily recoil on the subsequent phases of manufacture. The results at Mount Edgecombe, Natal, where the double carbonatation process has been recently introduced, have afforded abundant proof in this respect, as will be amplified later.

Carbonatation sugar made at the above-mentioned factory compares very favourably with "first refined" both in quality as well as in uniformity, and commands the same or only slightly lower prices. On the other hand, in comparison with "mill whites," turned out by the average sulphitation factory in the country, it is unquestionably superior, and, consequently, obtains an appreciably higher price. This difference in price alone should go a long way to compensate for whatever economical drawbacks may be inherent in this process. But, apart from the quality of the sugar, a very important advantage is the reliability of its uniformity, which until lately was the prerogative of "first refined." In this connexion, it is interesting to recall that a serious endeavour has recently been made, in the nature of a Sugar Commission and a Government Conference, to enquire into, among other questions, the payment of sugars on the fixed basis of "first refined," and to introduce instead the payment on the realization of sugars actually turned out by individual mills. So long, however, as the "mill whites" turned out by the different factories are of such widely varying quality, it is naturally difficult for the planters to accept this method of payment. It would appear from the above that one direction of overcoming this difficulty may lie in the production of carbonatation sugar.

[1] These sugars will henceforth be named "mill whites."

Last, but not least, while the cost of manufacture of carbonatation sugar is doubtless higher than that of sulphitation sugar, it is, or should be, less than that of "first refined."

All the above circumstances lead us to think that, once the carbonatation process has firmly struck root, and once the consumer gets accustomed to the new standard of sugar, the opinion expressed by Dr. TEMPANY in the course of his evidence before the Sugar Commission, namely, that in a country, such as Natal, a sugar refinery is "an absolutely unnecessary excrescence" may yet in a measure be appreciated.

After this somewhat lengthy, but, we think, necessary introduction, we shall now proceed to our theme. In dealing with this subject, it is not proposed to enter into a purely technical study of the carbonatation process, which already appears in various publications, but rather to discuss the pros and cons of this process, particularly from the economical point of view.

THE SULPHITATION PROCESS.

The Uba Cane.—The juice of the Uba cane,[1] as compared with that of other cane varieties, is especially characterized by a high content of gummy ingredients and cane wax, to which the refractory nature of this juice is mainly attributed. Those bodies of unknown constitution coming under the category of "gums" are particularly notorious, and are rightly regarded as the worst enemies of sugar manufacture in Natal and Zululand.

Analyses appear to show that, under normal circumstances, the difficulties arising from these viscous substances are not so much due to their quantity as to their quality. Naturally, the proportion in which these constituents occur in the juice varies considerably and depends, among many other factors, on the state and age of the cane and condition of growth.

Although the gummy ingredients of the Uba juice are met with to a greater or less extent throughout the milling season, they become conspicuously obstructive after a prolonged spell of drought, or in cases where there has been too long an interval between burning[2] and milling of the cane, especially when this coincides with unfavourable conditions of the weather. Furthermore, it has been observed that "flats" cane, grown on certain areas, and those subject to flood break-aways and bad drainage, manifest the same features of "gumming." To enter into a study of the causes of these gums is beyond the scope of this paper; that they exist is a fact only too familiar to the sugar makers in this country. Our present object is rather to find out how the attendant difficulties may be fought and overcome.

How do these gums affect the various phases of manufacture? The origin of the difficulties and complications experienced in the different stages of manufacture may be traced back to the clarification of the mill juice. Owing to the inadequate amount of lime used in sulpho-defecation factories, only a very small part of the gummy matter is precipitated and removed, so that the evil effects of the remainder are reflected through the whole course of manufacture. The noxious influence of these bodies is particularly apparent at the filter-presses and vacuum pans. Assuming gummy juices, the process of manufacture would be affected as follows:—

[1] The Uba cane is at present the universal variety grown in Natal and Zululand.

[2] The practice of burning the cane prior to cutting is general in Zululand, and is also carried out to a greater or less degree in Natal.

Settling.—To begin with, the settling process of the juice in the subsiders is retarded and rendered imperfect on account of the suspended ingredients having escaped precipitation. It has been observed, when gummy canes are being crushed, that the time of subsiding is doubled or even trebled; and in spite of this fact the decanted juice remains turbid.

Filtering.—Next come the filter-presses. In Natal and Zululand, this station is a troublesome one at the best of times; but it becomes verily a heart-breaking affair when the gums begin to show their "form" in earnest. The filters then work only a short time before ceasing to run completely. If, in such circumstances, the filter-press is opened, it will be seen that the cloths are covered over with a thin slimy layer of scum which clogs the pores. In consequence, these cloths have to be changed and cleaned frequently, thereby causing a great deal of direct and indirect losses.

Passing the evaporation station, where the irregularities are less noticeable, we come to the vacuum pans.

Vacuum pans.—One need only touch on this subject with pan boilers in this country in order to appreciate the troubles they have to cope with from time to time. A strike which under normal conditions, as a rule, takes six hours, may last from 10 to 15 hours, according to the gumminess of the syrup; and, even then, the resulting massecuites are far from satisfactory. It has frequently been noticed that when boiling syrups containing a high percentage of gummy matter, the formation of false grain is almost inevitable. Only by boiling very slowly, which of course entails a decrease in the capacity of the pans, can this evil be remedied to any extent; even then, it often occurs that false grain is nevertheless formed in the crystallizers. In one particular instance, on taking a sample it was found that by slightly acidifying the concentrated juice with acetic acid and subsequently heating the sample, the latter was converted into a jelly-like substance. It is evident that under such circumstances a normal process of boiling can hardly be expected.

Crystallizers.—In view of the fact that pan boiling and crystallization-in-motion go hand-in-hand, it stands to reason that kindred difficulties will be experienced at this station.

Centrifugals.—Owing to the viscosity of the mother-liquor, the separation of the sugar crystals in the centrifugals must be unfavourably affected.

When treating gummy juices, a very considerable increase in the centrifugal treacles will be noticed; in other words, under like conditions, such juices give a greater percentage of after-products than pure juice. Moreover, the exhausted molasses (treacles) resulting from canes containing much gummy matter will necessarily be of higher sucrose content, which of course means a decreased recovery.

Taking the process of manufacture as a whole, it is clear that the excess of gums, which remains unprecipitated, is responsible not only for direct sucrose losses, but also for indirect economical losses, which together at times can be considerable. Moreover, it is essential for the preparation of superior white sugar that the syrup should be, besides colourless, quite clear and bright, and not cloudy or even opaque, otherwise the fine particles of the insoluble matter left floating will be incorporated with the growing crystals, rendering them discoloured. The presence of these viscous bodies in the concentrated juice would therefore impair the appearance and thus the commercial value of the sugars.

We have so far dealt with the troubles and losses arising from the gummy constituents of the Uba cane. What is the remedy? The reply is: Thorough elimination of the gummy impurities.

Carbonatation Process.

This elimination may be achieved by means of the combined action of a considerable excess of lime and carbon dioxide gas, whereby, besides other impurities, the main part of the gums is precipitated.

The efficiency of this method of purification appears to be due not so much to the strong alkaline reaction to which the juice is subjected as to the copious precipitate that is formed within the juice.[1] This calcium carbonate during the process of formation adsorbs non-sugars;[2] and, it furthermore, envelops the floating impurities and forms so dense a mass that the slimy particles are incorporated among the hard grains, with the final result that a copious precipitate of a granular structure is produced, which is readily separated from the juice in the filter presses.

Before entering further into the study of the carbonatation process, it may be as well to compare its effect on the gums in the different stages of manufacture with that of the sulphitation process on the same lines as described above.

It may be stated at once that the substitution of carbonatation for sulphitation removes almost completely the troubles in connexion with the treatment of gummy juices. Even when crushing gummed canes in very bad cases, the treatment of carbonated juices is not materially affected. This fact has been fully endorsed by the results in Natal, viz., at Mount Edgecombe where the double carbonatation process is in operation.

Juice filtration.—Of prime importance in the treatment of Uba juices by carbonatation is the ease with which they can be filtered, irrespective of their original state of viscosity. This is due to the creation of the course-grained precipitate which constitutes an excellent filtering medium. The filter-cakes ormed are so permeable that they can be readily and efficiently washed with water and exhausted by steam. The result is that the loss in sucrose at this station is very small; indeed, notwithstanding the larger quantity of carbonatation scums, the total loss in sugar is about the same as, or less than, that occurring in sulphitation mud, which is considerably less in quantity but contains more sucrose.

Syrup filtration.—Being practically free from gummy impurities, the concentrated juice of carbonatation factories is filtered again. The result is a colourless and beautifully clear and bright liquid which forms an ideal medium for the production of a superior kind of white sugar.

Vacuum pans.—It stands to reason that such pure syrups are easily and advantageously boiled in the vacuum pans. Independent of the condition of the cane crushed, the time for a strike remains more or less normal and the pan-boiler has no need to worry about his bugbear "the gums."

Crystallizers and centrifugals.—In addition to the smooth and easy working of the massecuite in the crystallizers and centrifugals, which is assured by the carbonatation process, the resulting molasses is less in quantity, clearer, and of a lighter colour than those derived from the sulphitation process; and as clear molasses (treacles) can be more thoroughly desaccharified than those which are sticky and gummy, it is evident that the loss of sucrose in the molasses in a carbonatation factory is smaller than in a sulphitation factory.

In the above we have discussed in a general way the peculiar nature of the Uba juices, and how the attendant difficulties may be evercome, from which we may draw the following conclusions:—

[1] As shown in De Haan's investigations which led to his process.
[2] Prof Boldingh, *Tydschrift*, 1923, No. 10.

From the point of view of coping with gummy juices, the carbonatation process is superior to the sulphitation process, for in addition to a more thorough clarification it ensures the rapid and uninterrupted run of all the manipulations which are the essential requirements in the manufacture of white sugar.

CARBONATATION *v.* SULPHITATION.[1]

It is now proposed to compare these two methods of clarification in regard to the following headings:—(*a*) The yield of sugar; (*b*) The costs of manufacture; (*c*) The quality of the sugar; and (*d*) The costs of the installation.

(*a*) *The yield of sugar.*—The recovery of sugar from the juice is governed by the mechanical and chemical losses sustained during the process of manufacture. These losses have been the subject of elaborate investigation in Java by DE HAAN[2] and by VAN DER WANT.[3] Their results are given in the following table in which the figures are based on 100 parts of sucrose entering in the raw juice. These figures do not represent all the losses that occur during the manufacture, but only those which appear to differ in the carbonatation and the sulphitation process.

	CARBONATATION.		SULPHITATION.	
LOSSES IN	DE HAAN.	VAN DER WANT.	DE HAAN.	VAN DER WANT.
Clarification of raw juice	0·58	1·35	1·414	1·414
Evaporation	0·81	0·81	0·675	0·675
Clarification of syrup	0·014	0·014	0·064	0·064
Molasses	5·14	8·03	6·78	8·71
Total of above losses	6·544	10·204	8·933	10·863

It will be seen that there is a difference between the final figures arrived at by these investigations. While DE HAAN finds a difference of 2·39 per cent. to the advantage of the carbonatation process, VAN DER WANT obtains 0·66 per cent. In the conclusion of his article, VAN DER WANT states that general practice in Java shows that this difference is usually even smaller. DE HAAN,[4] on the other hand, maintains that his calculations prove that the extra yield of sugar to the advantage of carbonatation is 2 to 2½ per cent., but he adds that this figure may be reduced to 1·5–2 per cent. by judicious "sweetening off" of the defecation filter-mud. This matter of greater yield is manifestly one of so intricate a nature that its accuracy is difficult to demonstrate by correct figures. At any rate, whatever the figure may be, it may be taken as an indisputable fact that more sugar is recovered from the juice by the carbonatation process than by the sulphitation method.

When considering the above figures in connexion with South Africa, it is essential to bear in mind the difference in quality between the juices in Java and those of the Uba cane. It is evident that the purity and physical nature of the juice play an important part in the process of clarification. When dealing with comparatively pure and facile juices, the energetic action of the carbonatation process is not given adequate scope to excel in comparison with the sulphitation method. The treatment of viscous and less pure juices, however, will tell quite a different tale. Therefore, if a similar Table to that given above is drawn up for South African practice, it may be expected that the difference in the total loss

[1] In referring to sulphitation factories in this paper, it is intended to embrace all factories based on the sulpho-defecation process, irrespective of the variations of procedure which have come to the fore from time to time.

[2] *Archief*, 1911, 1341. [3] *Ibid.*, 1914, 1084.

[4] *Archief*, 1917, 546.

between the two processes will be greater than in Java; in other words, that the superiority of carbonatation as regards the yield will be more pronounced.

The losses making up the extra difference between the Java and South African figures will be found chiefly at the filter-press station and in the molasses.

The filter-dirt of the Uba juices, as already mentioned elsewhere, is notoriously difficult to handle, and its sticky and slimy nature at times render it almost intractable. In sulphitation factories there, great difficulty is experienced in the process of exhausting this mud; and the sucrose losses incurred at this station are consequently considerably higher in comparison with other countries. The substitution of the double carbonatation process for the sulpho-defecation process at Mount Edgecombe, however, has apparently overcome the troubles in connexion with the filter-process. The filter-cake was no longer muddy and sloppy, but hard and granular; and the sucrose figures were very much lower than those obtained previously with the sulphitation process.

As to the molasses (treacles), it is an accepted fact, as already stated, that those of carbonatation factories, apart from their quantities being smaller, are much easier and better desaccharified than those of sulphitation ones. The difference is particularly striking when the molasses are derived from gummy juices, as is confirmed by the results obtained at Mount Edgecombe.

The following figures are interesting in comparing the two method of clarification with regard to yield of sugar: they are especially so in view of their having been obtained at one and the same factory, which had discarded the sulphitation process for the double carbonatation process.

	Sulphitation.		Transition	Carbonatation.		
	1917.	1918.	period, 1919.	1920.	1921.	1922.
Sucrose in cane	13·42	12·61	..	12·95	13·51	13·53
Purity of mixed juice	84·14	82·45	..	84·74	82·58	86·18
Purity of syrup	86·75	83·75	..	88·72	86·59	91·52
Sugar, per cent. juice	79·23	74·10	..	78·42	80·47	84·22
Sugar, per cent. sugar in cane	70·76	66·35	..	69·09	73·59	76·57
Sucrose in press-cake	8·57	9·69	..	5·99	2·35	0.67
Purity of exhaust molasses (treacle)	47·27	46·73	..	43·95	43·01	44·78
Total losses, per cent. cane	4·14	4·32	..	4·09	3·62	3·22

Class of sugar manufactured—

Sulphitation.

1917 .. 79 per cent. whites + 8 per cent. cargo + 13 per cent. molasses (treacle)
1918 .. 96 ,, + 4 ,, molasses (treacle).
1919 .. Transition period.

Carbonatation.

1920 .. 96·7 per cent. whites + 3·3 per cent. molasses (treacle).
1921 .. 98·8 ,, + 0·6 per cent. cargo + 0·6 per cent molasses (treacle)
1922 .. 98·3 ,, + 1·7 per cent. (molasses) treacle.

These figures[1] are striking, and scarcely need explanation. It will be noticed that the increase of purity between the mixed juice and the syrup is appreciably greater in carbonatation than in sulphitation; this figure being about 1·5 to 2·5 in the latter, while it is 4, and even as high as 5 in the last year, in carbonatation. Although these figures represent the apparent purity, there can be no doubt that the great increase implies a better purification. However, no undue importance should be attached to them in the comparison of different processes.[2]

[1] They are published with the kind permission of the Directors of Mount Edgecombe sugar factory.

[2] See Prinsen Geerligs, "Practical White Sugar Manufacture," page 63.

The figures representing the recovery of sugar per cent. juice, and the recovery of sugar per cent. cane, on the other hand, deserve more attention, especially the former. (In comparing these figures with one another, it must be borne in mind that in 1917 only 79 per cent. of "mill whites" were made, which, to some extent, affects the recovery figure favourably.) They clearly illustrate that a greater yield of sugar is obtained by the carbonatation process.

Again, the figures giving the "Total losses per cent. cane" are noteworthy. Of course, they embrace the work performed by the crushing plant, which may vary somewhat. Subtracting, however, the "Sucrose losses in bagasse per cent. cane" from the above figures, we obtain for the sulphitation years an average of about 3·00 and for the carbonatation years, an average of 2·30, thus about 0·7 per cent. cane less loss in the manufacture proper in favour of carbonatation.

Summarizing, we see that these results bear out what has been said above in favour of carbonatation; and it may be concluded that:—

A higher yield of sugar is obtained by the carbonatation process than by the sulphitation process, the difference in yield being greater the more refractory and gummy the juices are.

(*To be continued.*)

The Steam Consumption of Sugar Factory Engines.

By P. H. PARR.

The question of the steam consumption of the steam engines and pumps in sugar factories is of considerable interest, although usually it is of little ultimate importance. In common with a number of other so-called "chemical" industries, the principal use of steam in a sugar factory is for the purposes of heating and evaporating the liquors, and the power requirements are readily satisfied with an over-all thermal plant efficiency far greater than that obtained in even the most modern super-power stations.

Such statements as, since an ordinary slide valve engine uses 40 or 50 lbs. of steam per h.p.-hour, therefore a steam turbine using 30 or 35 lb. of steam per h.p.-hour is correspondingly more efficient, are not only misleading, but often the reverse of the truth as regards the chemical industries, from the commercial point of view of the ultimate total plant economy.

Of the total heat in the steam supplied to a steam engine or turbine, a part is radiated away and completely lost; another part is transformed into mechanical work; and the balance remains in the exhaust steam. In a power plant, the whole of this balance is abstracted by the cooling water in the condenser, and sent to waste, so that, for the highest efficiency of such a plant, it is of the greatest importance to reduce it to the minimum value possible. On the contrary, in a sugar or similar factory, the heat remaining in the exhaust steam is all utilized in the chemical processes, and usually, under modern conditions, the exhaust steam is insufficient for the chemical requirements, and has to be supplemented by the addition of direct steam from the boilers, so that any reduction in the steam passed through the engines simply means a correspondingly greater use of direct steam afterwards.

There have been cases, in the paper-making industry, where a manufacturer has been persuaded to throw out his "inefficient" steam engines, and to install "efficient" electric motors taking current from a central power station—the latter being very anxious to get hold of the constant load, to improve their power-factor—with the result that he has had a big bill for power, but found his own coal bill

retnained almost exactly the same as before, since actually he had been obtaining his power at a thermal efficiency of about 90 per cent., whilst the power station could only generate it at about 20 per cent. In a power plant, by far the greater part of the heat from the fuel is sent to waste by the condensers, but in a chemical plant, this heat is all utilized, and thus the question as to power production is totally different.

This point has a very intimate connexion with the question of electric driving in sugar factories. Suppose that a steam engine on certain work requires 45 lbs. of steam per h.p.-hour, and that a high-grade engine or turbine driving an electric generator uses only 30 lb. of steam per hour. At first sight the latter appears to give a steam saving of one-third, but then we notice that the efficiency of a generator of such sizes as are used in sugar factories, usually 500–800 K.W., does not exceed 92 per cent., and under the usual conditions of working, 90 per cent. is a very fair average value. The transmission losses in the cables between generators and motors will usually be at least 3 per cent., or an efficiency of 97 per cent.; then the efficiency of the motors will not exceed 88 per cent., and usually will be about 85 per cent. The net result is, that for 1 h.p. from the motors, there is required an output of $1/0{\cdot}90 \times 0{\cdot}97 \times 0{\cdot}85 = 1{\cdot}35$ h.p. from the generator driving engine, so that the nominal 30 lb. of steam per h.p. at the engine really means 40½ lbs. of steam for an actual effective h.p. at the ultimate machine, and by far the greater part of the apparent saving has disappeared. The additional cost of the electrical machinery and its upkeep, together with the extra cost of the necessarily higher-class supervision, more than accounts for the remainder. Electrical driving of some of the machinery is often of very great convenience, and has undoubted advantages, but these are to be found in the realm of practical convenience, and not at all in that of ultimate thermal efficiency of the plant as a whole.

It is worth noting that for this season in Jamaica, it was the electrically-driven factory which was shut down, the canes being crushed at one of the older steam-driven factories, and not a steam factory shut down in favour of the electric.

Before going into figures as to steam consumption, one other point may be mentioned, and that is, the small pumps. As is well known, they really are "steam eaters," but there are two very important facts which seldom receive proper consideration: first, even though they take a lot of steam in proportion to the power developed, most of it is passed through to the exhaust main, and is not ultimately wasted; and, second, the total steam taken by these small pumps is only about 5 per cent. of the total factory consumption.

With a few of the older sugar factories, particularly in Demerara and places where the conditions are somewhat similar, there is a considerable amount of exhaust steam wasted to the atmosphere: the real reason for this is that the evaporators are short of capacity; in many of these older factories the imbibition water has to be kept down because the evaporators cannot deal with more than 6 or 8 per cent., and consequently cannot utilize all of the exhaust steam. But in a modern factory, with an evaporator of ample capacity, 30 or 40 per cent. imbibition water is quite common, the evaporator and the calandria vacuum pans being able readily to absorb more than the normal exhaust steam from all of the engines, and a good modern practice is to connect the exhaust main to the live steam main through a reducing value, so as to maintain a constant pressure in the former. In such cases, the limit of the imbibition is determined by the value of the bagasse for steam generation, or, with the lower fibre canes, by the cost of extra fuel. With modern machinery and methods, the most satisfactory cane is that

with 14-16 per cent. fibre, which is just about right for a balance between steam generation and consumption. With lower fibre canes, extra fuel is required; with higher fibres, there is usually a surplus of bagasse. In Cuba, where high extractions are not of great importance, and in places where the final molasses, being distilled to produce rum or alcohol, are not fully exhausted, the conditions are somewhat different.

The usual steam pressures in modern sugar factories are now 100 or 120 lbs. per sq. in., there having been a gradual increase from the 60 lbs. of fifty years ago, through the 80 lbs. of the nineties, to the present values. It does not appear to be likely that there is any advantage to be gained by going beyond 120 lbs. for steam-driven units—and it is worth while noting that some factories, after working at 120 lbs. for a year or two, have dropped back to 100 lbs.—but 150-160 lbs., sometimes with 100–150°F. of superheat, is suitable for the generator engines or turbines where electric driving is adopted.

As between steam and electric driving, it should be noted that with the former the speed of each and every unit is readily and independently controlled by a turn of its steam-stop valve or reversing screw, but that motor-driven units cannot readily be varied in speed—this is especially important where the pumps are concerned. Direct current motors can be varied in speed, but they are not really satisfactory in sugar factories, the dust which is nearly always flying about playing havoc with the commutators. Alternating current motors can only be varied in speed when of the slip-ring type, which is not suitable for small pump motors of 3–10 h.p., whilst in any case the power consumption remains the same as at full speed, the difference being merely wasted in the resistances. With alternating current, the speed of the whole factory can be reduced, when cane runs short, by reducing the speed of the generators, and all engines or turbines driving such generators should have governors with speed regulating gear which can be adjusted without stopping them. The chief objections to this method of general speed reduction for the whole factory are that the centrifugal injection water pumps may (and probably will) cease to function, and that, in common with everything else, the speed of the sugar centrifugals is reduced, which appreciably increases the difficulty of curing to definite purities.

Turning now to the question of the actual steam consumption of sugar factory engines, there are practically no experimental data available at all. It is not commercially feasible to test these engines under working conditions in the maker's works, and most manufacturers never even joint up the cylinder covers. A very few firms make a point of running every engine under steam for some hours, but even they cannot arrange to test these large slow-speed engines at full power. With engines driving electric generators or centrifugal pumps, it is comparatively easy to make a full-power test up to 500 h.p. or even more, but a 500 h.p. cane engine running at 50 r.p.m. is an entirely different proposition, and a power test is seldom possible. Testing when at work in a sugar factory is generally quite out of the question—the important thing to do is to make sugar, not to obtain technical data.

As a result of some years study of the subject, the writer published in the *Mechanical World* for 29th Sept. and 6th Oct., 1922, an article on the "Steam Consumption of Steam Engines," in which he developed an original method of making the calculations, admittedly empirical, but with a certain rational basis, and shown to give values within about 5 per cent. of test results throughout a very wide range of working conditions.

For the three most common steam pressures used in sugar factories, we may say:—

	Lbs. per. Sq. Inch.		
Boiler pressure	80	100	120
Pressure at engine	70	90	110
Back pressure	3	6	10

and for these conditions, the method developed in the above-mentioned article leads to the following values for the mean effective pressure, in lb. per sq. in., and for the steam consumption in lb. per B.H.P., at a normal piston speed of 350–400 ft. per min. The M.E.P. is that referred to the B.H.P., and the actual indicated M.E.P. will be somewhat higher.

Mean Effective Pressure, Lb. per Sq. In.

	Boiler Pressure, Lbs per Sq. In.		
	80	100	120
Cut-off 30 per cent.	19½	26½	32
,, 40 ,,	25½	33½	40½
,, 50 ,,	29½	39	47
,, 60 ,,	33	43	52
,, 70 ,,	35½	46	55½

Lb. Steam per B.H.P.-Hour.

	Boiler Pressure, Lbs. per Sq. In.		
	80	100	120
Cut-off 30 per cent.	41	37½	36
,, 40 ,,	42	39	38
,, 50 ,,	44½	42	41
,, 60 ,,	48	45½	44
,, 70 ,,	52	49½	48

it being understood that the figures are given to half-a-pound merely as the result of calculations to smooth curves, and that actual results may very well vary 5 per cent. either way or even more.

The above figures apply to engines working with an open throttle; where the cut-off is as mentioned, but the power developed is reduced either by the partial closing of the steam stop valve, or by throttling from the governor, the steam consumption per B.H.P. hour is increased. Very roughly, if the actual cut-off is as given in the column at the left of the following tables, and the steam is throttled down so that the power developed is that corresponding to open throttle with the cut-off given at the top of the columns, then the steam consumptions will be as follow:—

Boiler Pressure 80 lb. per Sq. In.

Actual Cut-off.	Effective Cut-off Per Cent. 30	40	50	60
40	47½	42	—	—
50	54	48	44½	—
60	61	54½	50½	48
70	67½	60½	56½	54

Boiler Pressure 100 lb. per Sq. In.

Actual Cut-off.	Effective Cut-off Per Cent. 30	40	50	60
40	43	39	—	—
50	49½	45	42	—
60	55½	50½	47½	45½
70	62	56½	53	50½

BOILER PRESSURE 120 LB. PER SQ. IN.

ACTUAL CUT-OFF.	EFFECTIVE CUT-OFF PER CENT. 30	40	50	60
40	42	38	—	—
50	48	43½	41	—
60	54	49	46	44
70	60	55	52	49½

Naturally, the above figures are only approximations, but there is good reason to believe that they are very near to the truth. Corliss engines of course work always with an open throttle, the control being by cut-off, so that the earlier table applies all the time.

The next question is as to the steam consumption of the steam turbines driving electric generators, and in this connexion it appears to be desirable to draw particular attention to the fact that such steam consumptions as 10½ or 11 lb. per K.W.-hour, which are obtained at super-power stations with 20,000 K.W. generators; steam at a pressure of 250–300 lbs. per sq. in., superheated at 700° F.; and a vacuum of 29½ in. or more, have nothing whatever to do with sugar-factory working; also, as previously mentioned, such low steam consumptions at the engines, even if possible, would not be of the slightest advantage in the end, and would only mean the use of a correspondingly greater quantity of direct steam for the chemical processes.

The steam consumption of the highest grade turbines of twenty or thirty thousand horse-power can usually be estimated to within about 1 per cent. on the following basis: calculate the heat units given up by a lb. of steam on expanding adiabatically from the initial to the exhaust pressure; deduct 5 per cent. of this as radiation losses, which heat is absolutely lost; and then deduct 20 per cent. from the remainder, as an allowance for friction, final velocity of the exhaust steam, etc. (this latter heat remains in the exhaust steam). The residue is the number of heat units available for the production of mechanical work, and one h.p.-hour is equal to 2547 B.T.U.

For instance, with 120 lbs. at the boiler, 110 lbs. at the turbine, and 10 lb. back pressure, we have, using Marks & Davis' Steam Tables:—

	B.T.U. PER LB.
Heat in steam to turbine	1190·3
,, after adiabatic expansion to back pressure	1069·6
Gross heat available	120·7
Less 5 per cent. radiation	6·0
	114·7
Less 20 per cent. friction, etc.	22·9
Net heat available for power	91·8

giving 2547/91·8 = 27·8 lb. of steam as the minimum consumption per b.h.p. hour. For the small units used in sugar factories, 10 or 15 per cent. must be added, giving a final result of 30–32 lbs. of steam per b.h.p.-hour from the turbine, and adding 35 per cent. to allow for the efficiencies of the generators, transmission, and motors, as previously shown, gives a final result of 40-42 lbs. of steam per effective h.p. from the motors, which is considerably more than the consumption of a Corliss engine at 30-40 per cent. cut-off.

Now consider a higher pressure steam, with a little superheat, for the turbines; say a pressure of 150 lbs. per sq.in., with a superheat of 100°F., when we have

		B.T.U. PER LB.
Heat in steam to turbine	.. ..	1252·0
,, after adiabatic expansion to back pressure	.. ....	1099·5
Gross heat available	.. ..	152·5
Less 5 per cent. radiation	.. ..	7·6
		144·9
Less 20 per cent. friction, etc.	.. ..	29·0
Net heat available for powers	.. ..	115·9

giving 2547/115·9 = 21·9 lb. of steam per b.h.p.-hour for a large machine, or say 24-25 lbs. for one of sugar factory size; and adding 35 per cent. gives 32-24 lbs. of steam per effective b.h.p.-hour from the motors, which is appreciably less than before. We must, however, notice that, assuming the boiler feed water to be at 150° F., then to generate 1 lb. of steam at 120 lbs. per sq. in. requires 1073·7 B.T.U., whilst at 150 lbs. per sq. in. and 100°F. superheat it requires 1134·1, or about 5½ per cent. more heat, so that, as compared with a direct steam engine, the requirements of the turbine are equivalent to 34-36 lbs. of steam per effective b.h.p.-hour, or almost exactly the same as for a Corliss engine at 30 per cent. cut-off. The costs—initial, running, and repairs—of the complete electrical equipment will of course be much greater than those of the simple steam engines, and the flexibility is less, so that only in special cases is general electric driving likely to be of value, and it may be noted that general electrification is common only in Cuba, where, as is well known, economy of working is not nearly of the same importance as it is in most sugar-producing countries.

Of the steam consumption of either engines or turbines, it is near enough for most practical purposes to assume that 10 per cent. is condensed, either by radiation or by transformation of the heat energy into mechanical work, the remaining 90 per cent. being available as exhaust steam for heating and evaporating.

The only other point which will be dealt with in this article refers to the pumps. For centrifugal pumps for injection water or other purposes, a fair efficiency for the pump itself is 70 per cent.; a few reach 75 or even 77 per cent., but this is not usual. Thus, a centrifugal pump, supplying 1000 gallons per min. on a 40 ft. head, gives out a net water h.p. of $1000 \times 10 \times 40/33{,}000 = 12{\cdot}1$, and at 70 per cent. efficiency, the b.h.p. of the driving engine or motor must be $12{\cdot}1/0{\cdot}70 = 17{\cdot}3$, or, say, a 20 b.h.p. driving unit.

For the small duplex and other pumps, the steam consumption is very variable, but as the total amount of steam for such pumps is actually very small indeed, accuracy in the estimation is unimportant, and if an allowance of about 100 lbs. of steam per h.p.-hour is made, it will be quite satisfactory for all ordinary purposes. Flywheel type pumps usually use a little less steam than do duplex pumps, but the difference is negligible so far as total factory steam consumption is concerned.

It is often not realized that by far the worst "steam-eater" in a sugar factory is the raw juice heater, which takes something like half or two-thirds as much steam as does the evaporator, and, in comparison, the requirements of the pumps are insignificant.

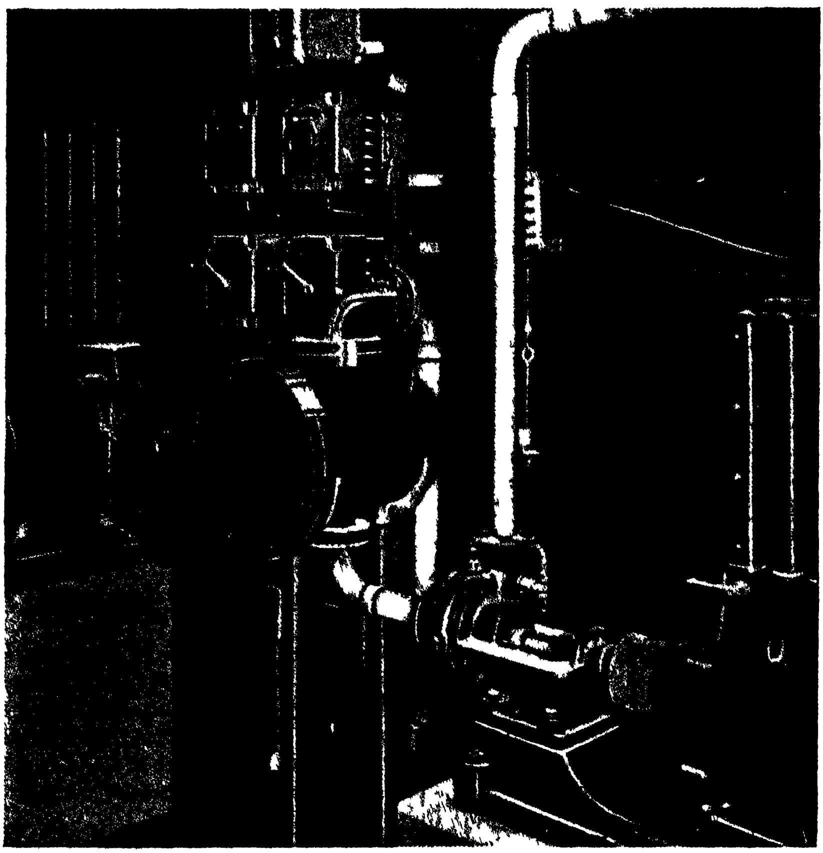
The writer hopes shortly to follow up this article by another on the steam consumption of a sugar factory as a whole.

The Trinidad cane crop, according to Tripp & Co.'s report, is doing well under favourable conditions, and there is every prospect of a good harvest next year.

The Seaborne "Interceptor" for the Priming of Pumps.

By C. J. H. PENNING, M. Amer. Soc M.E.

One of the inherent disadvantages of the centrifugal or rotary pump is that it needs to be primed before it can operate, the vacuum in the suction pipe being only created by the fluid leaving the pump housing through the delivery pipe. Therefore, it is impossible to use the full suction lift of a centrifugal pump; and it is necessary to make the fluid enter the pump under a slight head so as to ensure proper starting without previous priming.



Showing the arrangement of an "Interceptor" and electrically-driven Centrifugal Pump, as now generally used in modern sugar mill installations.

One way of obviating this difficulty is to fit a foot-valve to the end of the suction pipe. Not only do these valves cause a lot of trouble, but they restrict the free flow of the liquid and are apt to be kept open by small particles, branches, pieces of cane or cloth, etc., so that the column of liquid will drop out of the suction pipe when the pump is stopped.

Moreover, where pumps are used for irrigation or mill water supply, the foot-valve soon becomes very large and difficult of access, especially where the water is taken from a river, the water level of which is apt to change considerably. No foot-valve remains tight after some time, and after a prolonged stop it will always be necessary to prime a centrifugal pump, either by hand, or by using a vacuum-pump.

The Seaborne "Interceptor" overcomes all these difficulties, as it provides the means whereby a centrifugal or rotary pump is kept permanently primed, whilst there are no restricted passages in the suction main, no fine adjustments, and no valves. As a matter of fact, the efficiency of the pump is increased, as the "Interceptor" acts as a suction air-vessel, allowing the full suction lift of the pump to be utilized, and reducing "cavitation."

It is a receptacle placed in the suction pipe line just above the pump-housing. The suction pipe is connected to the top, whilst the pump draws the fluid from the bottom of the "Interceptor." The discharge pipe of the pump should be so long that on stopping the pump, the water contained in this pipe will be sufficient to fill the "Interceptor," when flowing back through the pump. Therefore, the pump will always be full of liquid, and when started up will immediately give the full bore delivery.

Figs. 1, 2 and 3 show the levels in the Interceptor during the starting up.

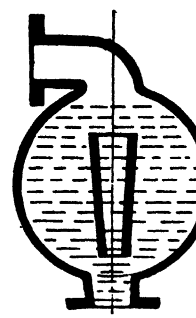


Fig 1.
Before Starting.

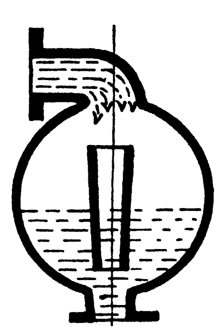


Fig. 2.
Suction Water entering "Interceptor."

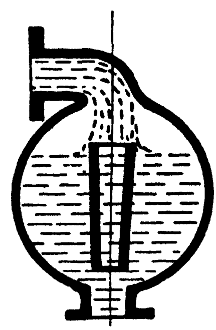


Fig. 3.
Maintained Normal Working Level.

Fig. 2 shows that the pump when started up draws liquid from the "Interceptor," creating a partial vacuum and causing the liquid to rise in the suction pipe until it enters the "Interceptor." The incoming liquid, assisted by the action of the internal tube, entrains the rarified air, so that after a short while (Fig. 3) the whole "Interceptor" will be practically filled. If the pump should suck air through the level in the supply tank or river dropping too low, there will be sufficient water in the discharge pipe to fill the "Interceptor," and as soon as the level is again sufficiently high in the supply tank or river, the pump can be started up. Diagrams A and B show the installation of "Interceptors" in connexion with water pumps for a factory supply, and it will be noted that the pumps are placed well above the water level.

From the above we see that with an "Interceptor" it will in most cases be unnecessary to place the centrifugal or rotary pumps in a pit, so that they can be placed on the factory floor level, or in the case of a water-supply pump, higher up the river bank. In the case of juice pumps, it will be possible to use automatic

starting and stopping devices, operated by floats, without the necessity of having the pump placed below the supply tank. If there is absolute certainty that the pump will not suck air, the discharge need not be higher than the top of the "Interceptor," but for nearly all pumps in a cane sugar factory a long delivery pipe is required; especially where centrifugal pumps have to draw from vacuum is the "Interceptor" a help.

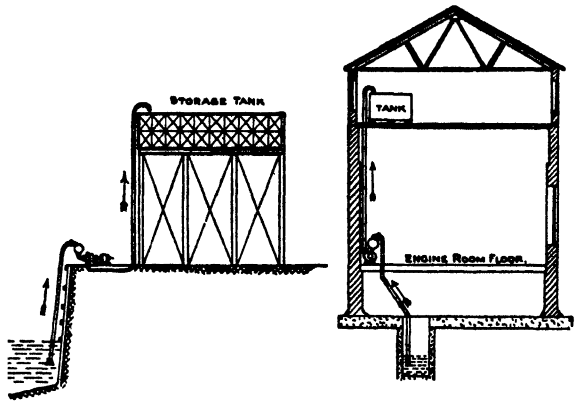


DIAGRAM A.—HIGH SUCTION–HIGH DISCHARGE.
Hand or Automatically Operated.

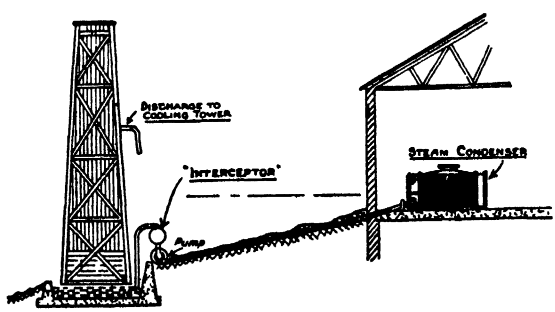


DIAGRAM B.—SHORT SUCTION—LONG DISCHARGE.
Large Quantity of Water. Continuous Service.

It is built in sizes up to 6 in. suction in cast-iron. For the larger sizes it is built in steel or reinforced concrete with iron fittings. It is patented at home and abroad, and it should provide an aid for the solution of pumping problems in cane fields and cane factories.

A German chemical firm has put on the market sealed glass tubes containing reagents for the preparation of the principal standard solutions used in volumetric analysis. Each tube contains the exact equivalent of the reagent for the preparation of 1 litre of a N/10 solution. A convenient device is supplied at the same time for introducing the reagent into the litre flask without loss, this consisting of a funnel in the lower part of which is a pointed piece of glass against which the tube or capsule containing the chemical is broken. It is claimed that the manipulation involved in the preparation of standard solutions in this way is so simple that it can be performed by an untrained assistant. But the principal feature of the proposition is that it provides a supply of volumetric reagents, the concentration and purity of which are guaranteed.

Neutral Clarification, its Determination, and its Effect on the Lime Content of the Clarified Juice.

By A. H. ALLEN, Fajardo Sugar Co., Porto Rico.

Desirability of Neutral Clarification.

In the case of a raw sugar factory desiring or having to practise neutral defecation of the juice, the question of the selection of a suitable indicator for determining the reaction of the juices must be decided. Many theoretical and practical considerations indicate that a nearly neutral clarification is desirable, and in many cases, is absolutely necessary. It is a known fact the amino-acids exert a protective action toward the reducing sugars present, with respect to their destruction by lime under the influence of heat. For instance, some juices are of such a nature that relatively large amounts of lime may be used in defecation, almost with impunity, little or no destruction of the reducing sugars resulting. But again, other juices are of such a nature that even the faintest excess of lime for neutralization may cause considerable decomposition. This peculiar difference of behaviour is controlled by the content and nature of the amino-acids contained in all juices.

Phenolphthalein and Litmus as Indicators.

An almost universal indicator used in factory operation is phenolphthalein; but unfortunately it fails to function rightly with all juices, or even consistently. The same amino-acids which produce a protective action against the destruction of reducing sugars by lime are the source of this irregularity; and it usually follows, that the higher their content, the less valuable becomes phenolphthalein as an indicator of alkalinity and acidity. Litmus is generally considered as the most correct and suitable indicator for control work; but is not suitable for factory operation when placed in the hands of unskilled native labour, especially so when it is desired that the juice be limed uniformly as near the neutral point as possible.

It is often found that juices neutral to litmus will have an acidity of from 0·003 to 0·007 per cent. as CaO with phenolphthalein, depending on the amount of substances in the juice which affect the action of this indicator. Most factories using phenolphthalein determine this difference between the litmus reaction and that of phenolphthalein, and apply this correction to the factory operation. Thus, the raw juice is limed to such a point that neutral clarified juice results, or any degree of alkalinity desired, using litmus. The titre of the raw limed juice with phenolphthalein is noted at the same time. Now supposing this to be 0·5 c.c. of N/28 HCl, then the operator at the liming station would add lime to the juice until a faint reaction for alkalinity is obtained after adding 0·5 c.c. of N/28 NaOH and testing with phenolphthalein. Or, again, suppose an alkalinity of the clarified juice was desired, say 0·002 CaO per 100 parts of juice, then lime would be added to the juice until a phenolphthalein reaction for alkalinity resulted after adding 0·3 c.c. of N/28 NaOH. To lime this way it is necessary to have three liming tanks, one receiving raw juice, one being limed, and one being emptied, thus allowing of a continuous cycle.

This method of liming requires a titration station at the liming tanks, with burettes and standard N/28 NaOH, and in conjuction the litmus control titration of the clarified juice must be carried out in the laboratory to determine the amount of standard soda necessary to add when testing alkalinity of the raw limed juice, as this amount varies considerably, especially with canes of different growth and age, and with rainfall, weather and other conditions. In practice it has been found that no great variation from day to day is to be encountered. Many

factories working ordinary defecation processes are running the liming station in this way, or preparing to do so.

The writer has found that the use of litmus for control purposes is a serious problem; it is difficult to secure litmus paper having sufficient sensitivity, and litmus that does not vary somewhat one lot with another. Also, it is difficult to secure laboratory men who will exercise the necessary amount of care and patience in making the titration; the results are apt to be none too close and none too consistent.

SUITABILITY OF CORALLIN SOLUTION AS INDICATOR.

It was found that corallin solution as an indicator gave results checking with litmus, that its use was much more simple, and much more certain, and that the chemists preferred it. Corallin does not respond instantaneously and a little patience is needed when approaching the end point. The colour changes from yellow in acid solutions to rose, to violet red in alkaline solutions. A little practice will enable one to easily distinguish between the intermediate stage, rose red, and the end colour, violet red. To an alkaline juice a measured amount of standard acid is added, and this is titrated to the desired shade of red. From the difference in the acid and alkali used, the acidity or alkalinity is determined. The least change in the liming, is easily noted in the clarified juice. The titration is made in a flat-bottom, porcelain crystallizing dish, using 20 c.c. of juice and N/14 HCl and NaOH solutions. Dishes about 6 in. in diameter are suitable, and about 1–2 in. of distilled water is added. The amount of soda required to give the desired red with this volume of water is noted, and this correction may be made if so desired; but if the standardization of the acid and soda is made under the same conditions it is not required. Corallin is quite sensitive and may easily be used for titrating raw mill juices, even at night if the lights are in the right place for proper illumination. As the result of many tests it has been found to check with litmus much more closely than any other indicator tried, such as logwood, phenolphthalein, brom-thymol-blue, brom-cresol-purple, etc. The colour changes with the last two indicators are impractical for use with cane juices, though their sensitivity and correctness for the purpose leaves nothing to be desired.

EFFECT OF NEUTRAL CLARIFICATION ON THE LIME CONTENT OF THE JUICE.

Having perfected a *modus operandi* for securing neutral defecation with great exactness, or defecation of any degree of alkalinity desired, it seemed worth while to study its effect on the lime content of the juice. It may be added here that a study of the lime content of the juice before and after defecation leads to the securing of means for neutral defecation, it having been found that a clarified juice resulted with a minimum lime content when neutral in reaction. The factory in question, Central Fajardo, Fajardo, Porto Rico, where this was worked out, has juices of such a nature that the least excess of lime causes irregularities in the process, pans becoming hard boiling and sugars hard spinning, while the destruction of appreciable amounts of reducing sugars results. At times the phenolphthalein titre of the limed raw juice showed an acidity of 1·0–0·5 c.c. of N/28 NaOH with a neutral clarified juice issuing from the defecators when tested with corallin or litmus. The amino-acids seemed to have no protective action whatsoever toward the reducing sugars; and any excess of lime however slight caused a mucky, black coating on the pan coils, easily washed off with a spray, but highly resistant to the transmission of heat. The use of soda ash in any amount had absolutely no effect in correcting this action. The addition of

soluble soda soaps to the pans did give some results towards ameliorating these conditions, and helped to tide over particularly bad boiling periods. Correction of these results was found only in practising neutral defecation, which of course at certain periods of the grinding season produced troubles at the filter-press station. To obviate this, a little more lime was used at the mud tanks alone, or kieselguhr was added in the milk-of-lime.

It is thought that organo-silicious substances soluble in alkalies and alkali earths occurring in the juice are the cause of this difficulty.[1] Neutral defecation and acid defecation cause the precipitation of considerable quantities of these organo-silicious compounds; whereas, any excess of lime tends to make them soluble and more colloidal, thereby aggravating the fouling of evaporator tubes and pan coils, where they decompose somewhat on concentrating. Adding excessive amounts of lime at the mud tanks before filtering the scums, seemed to indicate this also, as heavily limed scums filtered much better than normally limed scums, while low limed scums were practically unfiltrable. The excess of lime put the organo-silicious colloids into solution, making the scums filtrable; but this made matters worse for the boiling stations, as was to be expected. A probable remedy, where permissible, would be to heat the juice to 116–120°C. before liming, then lime and settle as usual. This would break up the organo-silicious compounds before the lime could act upon them.

Acidity, Alkalinity, and Calcium Content of the Juice.

The following tables give data on juice acidities, alkalinities and CaO in the juices, and show how fast the CaO per 100 Brix in the clarified juice changes with a very slight difference in acidity or alkalinity, as the case may be, of the clarified juice. They also point out the decided advantage of neutral defecation for this kind of juice. One thing to be noted is that the acidity of the raw juice plus the lime in the unlimed raw juice (both as CaO per 100 Brix) should be an index of the CaO to be expected in the clarified juice. This is not the case, however, as the CaO per 100 Brix in the clarified juice is seldom much over the CaO in the unlimed juice, except where liming beyond neutrality has taken place, i.e., an amount of lime equal to the original acidity of the juice is precipitated. This is a case very different from many instanced by standard authors in their publications on sugar factory control.

Table I.

Acidities, Alkalinities, and CaO per 100 Brix.

Raw Juice Acidity, per 100 Brix. *I.*	Raw Juice, CaO per 100 Brix. *II.*	Sum of *I* and *II.* *III.*	Clarified Juice, CaO per 100 Brix. *IV.*	Difference, *III* and *IV.* *V.*	Syrup, CaO per 100 Brix. *VI.*	Clarified Juice, Alkalinity per 100 Grms. *VII.*	Filter Juice, Alkalinity per 100 Grms. *VIII.*
0·111	0·416	0·527	0·421	0 106	0·388	0·001	0·013
0·109	0·417	0·526	0·458	0 068	0·430	0 001*	0·013
0·109	0 417	0·526	0·458	0·068	0·430	0 001	0·014
0·130	0·438	0 568	0·486	0·082	0·491	0 002	0·021
0·128	0·436	0·564	0·477	0·087	0·477	0 001	0·017
0·130	0·434	0·564	0·481	0·083	0·463	0·002	0·012
0·132	0·438	0·570	0·465	0 105	0·446	0·003	0·008
0·135	0·408	0 543	0·430	0·113	0·422	0 005	0·007
0·137	0·416	0·553	0·436	0·117	0·416	0·005	0·008
0·137	0·402	0·539	0·404	0·135	0·404	0 004	0 007

Phenolphthalein was used for the titration of alkalinities.

[1] *I.S.J.*, 1921, 579; 1923, 358. * Acid.

Table I shows a record for the year 1921 using phenolphthalein, and brings out clearly the disturbing effects of the amino-acids on phenolphthalein, as the clarified juice is invariably acid, even as high as 0·005 per cent. CaO, while the litmus titration shows it be alkaline, and also the CaO in the clarified juice, rising over the CaO in the raw untreated juice brings out this fact. In fact during this year the operation of the factory was based on the CaO in the juice entirely, disregardful of the acidity as shown by phenolphthalein.

Furthermore, the phenolphthalein tests varied so much individually, that they were useless.

Table II.

ACIDITIES, ALKALINITIES, AND CAO PER 100 BRIX.

Raw Juice, Acidity per 100 Brix. *I.*	Raw Juice, CaO per 100 Brix. *II.*	Sum of *I* and *II.* *III.*	Clarified Juice, CaO per 100 Brix. *IV.*	Difference, *III* and *IV.* *V.*	Syrup, CaO per 100 Brix. *VI.*	Clarified Juice, Alkalinity 100 Parts. *VII.*	Filter Juice, Alkalinity 100 Parts. *VIII.*
0·167	0·454	0·621	0·526	0·095	0·482		
0·169	0·458	0·627	0·644	0·017	0·600	Phenolphthalein	
0·137	0·485	0·622	0·473	0·149	0·490		
0·098	0·452	0·550	0·451	0·099	0·464	0·001	0·009
0·099	0·437	0·536	0·461	0·075	0·458	0·000	0·006
0·111	0·464	0·575	0·450	0·125	0·458	0·001*	0·006
0·115	0·442	0·557	0·446	0·111	0·459	0·001	0·005
0·127	0·412	0·539	0·433	0·102	0·440	0·002	0·008
0·130	0·374	0·504	0·398	0·106	0·416	0·000	0·005
0·132	0·363	0·495	0·390	0·105	0·415	0·002	0·008
						0·001	0·007

Corallin was here used for the titration of alkalinities.

In 1922 the regular control method of the CaO in the juices, with the liming at the liming station determined by the phenolphthalein-corallin difference method as outlined at the start of this article for neutral defecation, was inaugurated. At once one sees the more consistent results in the comparison of the CaO in the untreated and the clarified juices. It is also seen that, as the alkalinity of the clarified juice goes up, the CaO rises likewise. It may be added that wherever the alkalinity per cent. rose as high as 0·002 it was intentional, and no fault of the method of control, which is capable of an exactness of 0·001 per cent. at the outside. Both Tables I and II give average figures for 15 days, taken arithmetically day by day from the laboratory sheets.

The determination of lime in the raw and clarified juices offered no particular difficulty, and was accomplished by the Clark soap method, the details of which may be found in any standard reference on water analysis, and in most works on sugar chemistry. As practised at Fajardo, 20 c.c. of juice was tested with N/14 potassium palmitate soap solution (made from pure olive oil). Suitable tables for determining the CaO per 100 Brix are given in most standard works on sugar factory control.

It has been decided that the Agricultural College at Trinidad shall change its title from "The West Indian Agricultural College" to "The Imperial College of Tropical Agriculture." This, as the new title suggests, is dictated by the belief that the college will thereby appeal to a wider circle of students than its original title would warrant. This wider claim to recognition will of course render it all the more obligatory that its standard of education shall be placed and maintained on a very high level.

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* Acid.

Report on Entrainment in Evaporation in Hawaii.[1]

Quite a few factories are again experimenting with different devices to reduce the entrainment in evaporation; and Mr. A. FRIES, Chemist to the Honokaa Sugar Company, reports as follows:—

The separators or "save-alls" used in former years in the vapour pipes of evaporators had as their principal feature the sudden reduction in the vapour velocity, thus bringing about the bursting of the bubbles, which contain vapour and sugar. In conjunction with this reduction in vapour velocity, baffle plates were used, these being so arranged as to cause a reversal of the vapour current, and the throwing of the bubbles against the plates. A design of separator extensively used in the islands for some years is made of a series of short tubes inserted in three or four sheets. The whole is placed in an enlarged section of the vapour pipe, the vapours generally passing the tubes in a horizontal direction, or it was placed in the dome of the evaporator cell, in which case the vapour traversed the tubes vertically.

The difference between this type of "save-all," known as the Stillman, and the first, is that there is no sudden reduction in vapour velocity, as the area of the tubes is only slightly larger than the area of the vapour pipe. Not having this principal feature of the old style "save-all" may account for the fact that in some instances the Stillman has not been sufficient to stop entrainment in evaporators. In one factory using Lillie evaporators, the Stillman traps reduced, but did not eliminate, the loss. Another factory, using a Stillman of the vertical type, in connexion with a standard evaporator, showed considerable entrainment, but this was completely stopped after putting in a 6 ft. belt and installing baffle plates inside the vapour space of the last cell.

At the Honokaa factory during the 1921 crop, there was quite a loss of sugar through entrainment in the evaporator. To remedy this the old baffle plates were removed and replaced during the off season by a Stillman trap, placed inside the last cell above the top flange. The entrainment from the start was much greater than in the previous year, amounting at times to a loss of 1000 to 1500 lbs. of sugar per 24 hours. As there was nothing wrong with the evaporator, or the method of operating it, the fault could only be with the newly installed Stillman. This was confirmed when it was found that the difference in vacuum above and below the trap was three-fourths of an inch. To stop further loss as quickly as possible, wooden baffle plates, as a temporary arrangement, were installed in the early part of the season, but as these accomplished what was desired they were kept in use throughout the rest of the crop. There is nothing new about the arrangement of these baffles. Mr. ORTH introduced it with good success at Koloa, and later the Makaweli Factory installed the same system, thereby completely stopping all entrainment. After placing the wooden baffles in the Honokaa evaporator, the entrainment loss was reduced to a reasonable figure, when running at the rate of forty tons of cane per hour, while at a lower rate of evaporation no sugar could be found in the condenser water. It is expected that after replacing the wood by iron that the entrainment would be eliminated under any condition of evaporation. It may reasonably be concluded from the above that a Stillman trap is not in every instance capable of stopping entrainment, in fact it may increase it as the experience here has shown. The following data refer to the detail of design: Diameter of cell, 8 ft. 7 in.; top tube plate to top flange, 8 ft. 4 in.; diameter of vapour pipe, 26 in.; Stillman trap, number of tubes in one plate, 160; diameter of each tube, 2¼ in.; total area of tubes, 635 sq. in.; area of vapour pipe, 520 sq. in.

[1] Condensed from Reports of the Association of Hawaiian Sugar Technologists, First Annual Meeting, November, 1922.

Mr. W. R. McALLEP wrote: I was very much interested in the failure of the Stillman trap at the Honokaa factory to stop entrainment, as in all but two or three cases that have come under my notice, this style of trap has been very efficient. A possible explanation lies in the throttling effect of this installation. According to figures given me the tubes have an area of 4·4 sq. ft.; mercury gauges on the last body below and above this trap indicated, respectively, 24·5 in. and 25·25 in. vacuum, a difference of ¾ in. As this factory is 460 ft. above sea level, a correction of approximately ½ in. must be added to these figures, making them 25 in. and 25·75 in. With an evaporation of 30 tons of water per hour, some 8·4 tons would be evaporated in the last body. Under these conditions the vapour would enter this trap with a velocity of slightly over 150 ft. per sec., and leave it at 180 ft. The temperature of saturated steam at these two points would be 133° and 127° F. It appears probable that such instantaneous decrease in the boiling point would cause drops of juice carried along with the vapour to boil with almost explosive force, and that the resulting spray would be carried through the trap with the current of vapour.

Others seem to have had similar experiences with the Stillman trap. Mr. R. ELLIOTT tried to determine the exact quantity of sugar loss and gives the following description of his test: During September 18th to 23rd inclusive, a test was run on the entrainment indicator of the fourth effect to ascertain the amount of syrup entrained, the syrup being weighed, composited, and analysed every three hours. The data are as follows: Duration of test, 68 hours; entrainment collected, 1174 lbs.; density of entrainment, 12·3° Brix; analysis of entrainment, 10·3 per cent. polarization and 83·4° purity; vacuum in four cells and in the condenser, 1·16, 7·15, 13·92, 25·5 and 26·9 in. respectively.

This fourth effect is 7 ft. in diam., and contains 910 tubes, 1⅞ in. diam. by 54 ins. long, giving 2010 sq. ft. h.s.; height from top of tubes to centre of vapour pipe, 9 ft. 6 in.; the two vapour pipes to the central condenser being 24 in. diam. Each vapour pipe is fitted with two screens, one 5 × 5 mesh, the other 3 × 3 mesh, to retard any particles of syrup going over, these screens being placed 5 ft. apart, the smaller mesh, placed nearest the condenser. Using the above figures, the calculated velocity of the vapour to the condenser is 112·06 ft. per sec.: then 1174 × 0·1027/96·5 = 124·94 lbs. of 96·50° sugar that is returned to the fourth cell per week, or 1·84 lbs. per hour.

Mr. A. BARKER, Engineer at Halawa Plantation, presents the following description of an entrainment catcher of his own design: During the latter part of this season, a new type of entrainment trap was fitted to the last effect at Halawa, with very noticeable effect and success. This entrainment catcher is fitted in the regular vapour pipe from the third effect and consists of two principal parts, a true screw and a Venturi tube. Its action is based on the fact that the vapours passing to the condenser are travelling at a very high speed, averaging, for the season, 14,144 ft. per min. A true screw of 4 ft. was inserted for a length of 8 ft. in the vapour pipe, giving a centrifugal force 4·8 times greater than a 30in. machine at 1200 revs. per min. By this means, all liquids in suspension are thrown out to the walls of the pipe and no particles of liquid can possibly reach the end of the screw without reaching the walls, and splashing on these walls is, of course, negligible. By altering the pitch of the screw, the centrifugal force may be increased to any desired extent, and consequently, for any known speed and diameter of pipe, the requisite pitch can be determined easily when the length of screw is known. At the end of the screw is a Venturi tube. All the liquids on the walls of the pipe either return along the vapour pipe or are caught between

the Venturi tube and the walls and returned by the pipe to the third effect. In this case, with a 16 in. pipe, the Venturi tube was restricted to 13·5 ins. and yet no loss of vacuum was observable. Sugar bubbles were no longer seen at the foot of the water leg and α-naphthol always showed a negative test when applied to the condenser water. In designing a catcher of this type, the speed of the vapour is not only made use of, but is increased, if necessary to give the necessary centrifugal force that enables the particles of liquid to reach the walls of the pipe in the time allowed. This factor of time is the principal one to be considered, and, in conjunction with the rate of boiling, vacuum carried, length of pipe available and diameter of pipe, determines the pitch of screw and size of Venturi tube. The fact that this catcher saved over 128 tons of polarization during the season is an indication of what can be done with one of efficient design, though the labour employed in manufacture was of the regular unskilled mill type.

Milwaukee Meeting of the Sugar Section of the American Chemical Society.

The Autumn meeting of the American Chemical Society was held at Milwaukee, Wis., from September 10th to the 14th inclusive, and several interesting papers were read and discussed before the Division of Sugar Chemistry. Short abstracts of some of these are given below.

Colouring matters of the rind of purple cane.—J. F. BREWSTER. The colour of purple or red varieties of sugar cane has long been considered due to the presence of an anthocyanin. Using Willstatter's methods to isolate possible anthocyanins from the outer skin of the variety of sugar cane known as "Louisiana Purple," deep garnet to black precipitates were obtained which were soluble in methyl and ethyl alcohol with a deep purple red colour. It is doubtful if the purple colouring matter is an anthocyanin since these with acids form stable crystalline oxonium salts which in most cases are fairly easy to obtain; whereas in the author's experiments no salts were obtainable, the precipitates being amorphous and containing nitrogen and ash. The leaf colouring matters, chlorophyll, xanthophyll, and carotin are present in the purple cane skin as well as cane tannin. Cane sugar and potassium salts are also present in considerable quantity. The purple colour vanishes almost instantly when the cane is milled, and thereafter probably behaves similarly to the tannin, giving dark green colours with ferric ions and yellow to brown colours upon decomposition.

Clarification of refinery syrups.—H. Z. E. PERKINS. Refinery liquors and syrups are clarified at densities of 50-60° Brix. Defecating agents must be used which coagulate impurities quickly and form a firm porous film. Calcium phosphate and diatomaceous earth or kieselguhr form flocculent, fibrous precipitates which are much better coagulants than the granular carbonate and sulphite used with thinner solutions. Washed raw sugars are treated with kieselguhr alone. The wash syrup from the raw sugar must be carefully treated with lime and phosphoric acid, added separately. Lime serves two purposes, neutralization of organic acids and formation of the coagulating calcium phosphate. Many raw sugars to-day are troublesome to refine, having much organic non-saccharine substance.

Automatic laboratory char-filtration apparatus.—W. D. HORNE and E. W. RICE. A newly devised apparatus is described, which comprises an automatic feed, consisting of a bottle of the solution inverted in a cylinder having a long slim gooseneck; and a distributing tube which receives the filtrate and discharges it

from its lower end through outlets set at different levels, leading to a series of collecting bottles so arranged that, as each is filled in turn, the flow of filtrate finds its way to the next bottle.

The influence of acid concentration in the determination of ash in sugars by the sulphate method.—E. A. Adkins, Y. L. Pun and J. R. Withrow. A study of the sulphate methods, particularly the official method of A.O.A.C., and of the modified method of Jamison and Withrow[1] was made. Different strengths and different amounts of sulphuric acid were used; and concentrated acid was found to give lower results than the modified method. Acid of 1·2 of water reduced greatly the foaming of the Cuban raw sugar compared with that produced by other dilutions. In cases of refined sugar and commercial glucose, foaming was not increased by the various dilutions used. The authors recommend the modified method to be substituted for others if sulphate ash is desired.

The comparative ash adsorption of vegetable and bone-char.—P. M. Horton and P. T. Sengson. Comparison of the ash adsorbed by bone-char and vegetable char under equivalent conditions showed that, volume for volume, bone-char removes much more ash. When equal weights of the chars were compared, it was found that as the amount of char is increased (keeping the volume of the testing solution constant) that the relative efficiency of the vegetable char seemed to approach that of bone-char.

A precision method for the determination of dry substance in beet sugar juices.—R. J. Brown. Work carried out by the authors has shown that results checking within 0·01 per cent. can be obtained on pressed juice, diffusion juice, and thin-juice when using the sand dry method. For ordinary work the Spencer oven gives good results, and it is especially valuable when results are required in a short time. The largest single volatile impurity driven off from fresh pressed juice during drying in all the tests is carbon dioxide. The authors have reason to believe that the dry substance determination on all juices, as far as the thick juice, can be made accurately to 0·01 per cent.

Routine colour determinations in cane syrups and molasses.—F. W. Zerban and C. A. Watts. The photometric method described in a previous paper[2] requires much time and lengthy calculations. The procedure has been standardized, and tables have been calculated with which it is possible to arrive at the desired result for each effective wave length by one single division. The analyst can now finish three to four times as many determinations in a day as he did formerly.

Influence of water-insoluble matter upon the polarization of raw cane sugars.—G. H. Hardin. Results showing the water-insoluble matter content of a large number of raw cane sugars is given. In the case of 96° Cuban centrifugal sugar it was found to be 0·159, the range extending from 0·017 to 0·423. It consists of 87·5 per cent. organic matter (cane fibre, etc.), and 12·5 per cent. mineral matter (earth, scale, lime salts, etc.). The average error in polarization resulting from the presence of water-insoluble matter is + 0·021°, the range extending from + 0·001 to + 0·057°. In the case of a sugar contaminated with 3·48 per cent. sand, the error in polarization was found to be + 0·35°. Owing to the high water absorption capacity of cane fibre, a direct ratio is noted between moisture content of the sugars and the insoluble constituents.

The gums of sorghum syrup.—J. J. Willaman and F. R. Davison. Some seasons sorghum syrup has such a gummy consistency that it is more like a fruit jell than a syrup. It has been found that this is due almost entirely to starch in the juice, and not to pectin,[3] true gums being present in only very small amounts.

[1] *I.S.J.*, 1923, 435. [2] *I.S.J.*, 1922, 534 [3] *Cf. I.S.J.*, 1923, 497.

Some combination of climatic conditions, as yet unknown, causes the undue amount of starch to be formed in the juice. It can be prevented only by filtering the cold juice before defecating.

Corn stalk syrup investigations.—J. J. WILLAMAN, G. O. BURR and F. R. DAVISON. The possibility of manufacturing syrup from sweet corn stalks as a cannery by-product has been investigated for two seasons under Minnesota conditions. It could be manufactured by essentially the same process as sorghum syrup, using controlled defecation, filtration, and vacuum evaporation, and utilization of the by-products, bagasse and leaves, would be necessary in commercial practice. Cornstalk syrup is clear, reddish amber in colour, with a pleasant flavour. It is not a table syrup, but is an excellent cooking syrup, rivalling the best grades of sorghum and of molasses.

Observations on the hydrogenation of glucose.—P. M. HORTON and H. C. GEREN. The methods for hydrogenating glucose are reviewed, and their several faults are pointed out. An attempt to duplicate the methods, using platinum black as a catalyst, revealed the fact that oxidation, and not reduction, is the main reaction, if the solution is alkaline. An investigation of this reaction has yielded some information as to the nature of the equilibria in an aqueous solution of glucose.

Production of maltose syrup and solid maltose from corn starch.—H. C. GORE. A modification of the classical DUBRUNFAUT and CUISINIER method gave maltose syrup and crystalline masses of maltose of excellent quality.

Recent Work in Cane Agriculture.

THE MOSAIC DISEASE OF SUGAR CANE IN INDIA. *J. F. Dastur. Agricultural Journal of India, Vol. XVIII, V, September, 1923.*

This disease was first observed at Pusa in 1921 on the varieties D 99 and Sathi 131, but a careful examination of all the other kinds being grown showed no signs of it. Only a few sets of the former cane were planted, while there was an acre of the latter on the farm. As soon as the infection was noted, the whole of the Sathi was uprooted and destroyed, and none of this kind has been grown since in the field. The canes in other parts of India have been reported as entirely free from mosaic. The mottling of the leaves was characteristically shown, and in badly infected shoots hardly any stem was formed; cankering of the stem was not, however, observed, though this may be due to the practice of not growing any ratoons on the farm. Cuttings from the diseased plants were planted and grown under observation, and reproduced the usual mottling. Experiments in inoculating healthy plants with the juice of those infected were successful in certain cases. In 1921 Sathi was infected from D 99, the juice being obtained by crushing leaves in a mortar, diluting it with distilled water, and injecting it with a hypodermic syringe into the leaf buds and growing points. Such inoculated plants remained normal but for the discoloration of the leaves, while the control plants showed no mottling. Similar results were obtained by inoculating healthy Sathi plants with the juice obtained from diseased plants of the same variety. The common sugar cane insects of Pusa were tested as to transmission of the virus, but failed to give any positive results. In 1922 Sathi 131, Hemja, Saretha, and *Saccharum spontaneum* were inoculated with the juice of diseased leaves of Sathi 131; and of these Hemja alone was affected. In one case where there was no apparent effect from the injection of the diseased juice into Sathi 131, the ratoons allowed to grow from the inoculated plants showed mosaic. The experi-

ments thus show that mottling can be passed from plant to plant by injection of the juice. Sathi 131 is a nondescript cane received, from a plantation of that name, at Pusa in 1912, and it appears probable that it may have brought the disease with it. The variety has proved unsatisfactory because of its low sucrose content, and the author surmises that this may have been due to the presence of the disease in it, although this presence was not very evident from the non-ratooning practice on the farm. (The writer of this note has a distinct impression that, on comparing Sathi 131 with a Mauritius seedling of the same number, he concluded that there was no difference between the two. It is possible, therefore, that Sathi 131 is really M 131, and this is the more likely in that about 20 years ago there was a considerable importation of Mauritius canes into the newly opening Bihar cane planting district.)

MECHANICS OF INOCULATION WITH SUGAR CANE MOSAIC BY INSECT VECTORS. *E. W. Brandes. Journal of Agricultural Research, Vol. XXIII, No. 4, January 27th, 1923.*

It has been demonstrated with practical certainty that the only method for the natural spread of sugar cane or grass mosaic is through the agency of insects, acting as simple vectors or possibly as intermediate hosts. It was established by the author that *Aphis maidis* is capable of transmitting the disease, and this appears to have been generally accepted, although some investigators consider this fact to be of no great significance because of the scarcity of the insect on the cane plant. In view of this divergence of views the following brief summary is given of the experimental work thus far done, before proceeding to the new work on the subject now recorded.

BRANDES in 1920, as the result of experiments with a number of insects known to feed on sugar cane in the United States, announced that *Aphis maidis* was able to transmit the disease from plant to plant, but considered that other insects also might be found to do so.

In Porto Rico, where mosaic assumed a serious epidemic form, SMYTHE in 1919-20 obtained similar results with a number of insects, but there is some doubt as to the validity of his conclusions, since in some cases his test plants were put out in the open for a period which would allow natural infection to take place before examination. TOWER in 1920, working with a number of chewing and sucking insects, obtained only negative results. WOLCOTT in 1921-22 rejected *Aphis maidis* as a carrier of mosaic because it had not been found on the sugar cane in the island. CHARDON and VEVE, however, in 1922 came to a different result. They covered healthy cane plants in the field with cheese cloth and introduced *Aphis maidis* into the cage thus formed. The insects colonized on various grass weeds present, namely, *Eleusine indica*, *Panicum barbinode*, and *Echinochloa colona*, and when these were cut down the insects were observed to migrate to the sugar cane plants. After 66 days about 65 per cent. of the cane plants in the cage had become infected with mosaic. In a second similar cage into which *Aphis maidis* was not introduced, no mosaic appeared among the healthy cane plants.

BRUNER experimented in 1922 in Cuba with a great number of insects. Of these *Aphis maidis* alone was found to be able to transmit the disease; but, as it was not found to attack sugar cane in the field, it was not held responsible for the disease.

In Java, LEDEBOUR in 1921-22 obtained positive results both with *Aphis maidis*, called there *A. adusta*, and *Aphis sacchari*, but subsequently withdrew the latter. *Aphis maidis* was seen to be abundant on *Panicum colonum* and *Paspalum*

sanguinale, weeds in the cane fields, which were subject to mosaic; and he observed that occasionally the winged forms of *Aphis maidis* flew to the sugar cane. (See also the more recent work of WILBRINK,[1] where the capacity of *Aphis maidis* of transmitting mosaic in the fields has been fully demonstrated in Java.)

In Hawaii, KUNKEL in 1922 confirmed the ability of *Aphis maidis* to convey mosaic to the sugar cane, but failed with *Aphis sacchari*. He also found that *Peregrinus maidis* (the corn leafhopper) transmitted mosaic from corn to corn, but apparently not to sugar cane. He, however, made a very significant observation, namely, that a rapid spread of mosaic occurred after weeding a canefield in which *Eleusine indica* was infected with mosaic and *Aphis maidis* was abundant on it.

From this summary it is evident that the basal fact, that *Aphis maidis* is able to convey "sugar cane or more properly grass mosaic," is abundantly confirmed, by observations in the United States, Porto Rico, Cuba, Java and Hawaii: also that, while *Aphis maidis* prefers grasses to sugar cane, it frequently migrates to the latter in large numbers, especially after weeding operations.

Mechanics of Inoculation.—In an attempt to get an insight into the way in which inoculation of mosaic is performed by insects, *Aphis maidis* and *Peregrinus maidis* were killed suddenly in situ while feeding on the leaves and sections were cut through leaf and insect. For the purpose of comparison a much larger leafhopper, *Draeculacephala mollipes*, which is common in the United States but has not been shown to pass on mosaic, was added to the series. This experiment was found to be somewhat difficult to perform, especially because of the danger of the insect and leaf parting company while the preparation was being passed through the various necessary reagents before the stained sections could be obtained. Fortunately it was most successfully accomplished in the case of *Aphis maidis*, the insect principally concerned.

It was demonstrated that, in this insect, the penetrating beak is placed somewhere over a stoma, advantage being taken, for entrance, of such thin place in the epidermis of the leaf. The setae are then thrust in by pressure. At the same time a copious secretion is poured out from the salivary glands, which completely envelops the setae in a kind of sheath. This sheath is easily seen in the prepared sections, in that it is coloured a brilliant red by safranin, and its purpose appears to be to assist in the penetration of the tissues by the extremely delicate setae, because of the well known dissolving and digesting properties of the secretion. The course of the setae can be traced along all the places of least resistance in the leaf tissues,—through the cavity always present immediately below the stoma, past the thin-walled mesophyll of the leaf, between the thicker cells of the starch sheath, into the vascular bundle. Here a marked feature is the care with which the softer phloem cells are sought out: if the hard woody vessels are encountered, the setae either go no further or are gradually diverted in the direction of the adjoining phloem. The fact that the contents of the phloem cells are especially rich in substances of great nutritive value for micro-organisms is regarded as specially significant, and it is claimed by the author that a more perfect method of inoculation could hardly be desired.

This search for the phloem does not appear to be made by the setae of the sucking apparatus of the corn leafhopper, the evidence rather suggesting that the woody vessels are being aimed at. In the large leafhopper, on the other hand, the whole apparatus is so big that the tissues are disrupted wholesale, and no definite selection could well take place. The results obtained are illustrated by rather fragmentary microphotographs and, although these bear out the points mentioned above, it would have been an advantage to the reader if the author

[1] *I.S.J.*, 1923, pp. 346-351.

had made a simple diagram giving the conclusions which he has been led to draw from his observations. This is one of the many cases where a line drawing is so infinitely more instructive than a photograph.

CULTIVATED AND WILD HOSTS OF SUGAR CANE OR GRASS MOSAIC. *E. W. Brandes and J. Klaphaak. Journal of Agricultural Research, Vol. XXIV, No. 3. April 21st, 1923.*

Since 1919, when it was demonstrated that weed grasses were attacked by the same mosaic as sugar cane, the authors have made observations on a large number of grass species as well as graminaceous crops of the southern United States. As mosaic has not been observed to be passed on by seed, special attention has been devoted to perennial grasses, through which the annual weed flora might be regularly re-infected. Sugar cane is such a perennial, and it has been amply shown that mosaic is retained in the stools and reappears in the following ratoons. More than 40 grasses have been tested experimentally by artificial or by insect inoculation or by both; and, as a first result, 13 species have been shown to be susceptible to the same mosaic as sugar cane, and it is surmised that this number by no means includes the whole list. Tables are given of those giving positive and negative results, and it is worth noting that both *Saccharum spontaneum* and *S. Narenga* are included among the former. The authors moreover point out that the 13 susceptible species belong to the Paniceae, Andropogoneae and Tripsaceae, which are regarded by HITCHCOCK as the most highly developed tribes of the thirteen into which he divides the family of grasses. There are also suggestions that there are more than one type of mosaic in the Gramineae.

Full details are given in Tables of the various experiments and their results. The cell sap for inoculation was obtained, as before, by squeezing young stalks in a powerful press under mineral oil, so as to exclude air, and injected by a hypodermic syringe near the growing point. The "virus" of grass mosaic was found to be more sensitive and less stable than that in other cases, notably that of tobacco; and this made it more difficult to manipulate without loss of virulence. All the experiments were conducted in glass houses at Washington, hundreds of miles from any known infection in the fields. In several cases where no success was obtained by artificial injection, insect transmission (by *Aphis maidis*) proved perfectly successful. In some of the cases where it was found difficult to establish *Aphis maidis* on the hosts and where it disappeared after a day or two, the plants nevertheless showed subsequently that they had been infected, and exhibited all the signs of the disease after the usual period of incubation of 14-20 days.

The authors then describe a series of tests on corn varieties, and field observations are recorded of Sorghum, pearl millets (Pennisetum) and wild grasses. Following up the known immunity of the Uba or Kavangire cane, a collection of all the "canes of Indian affinity" that could be brought together were also tested. We note that *Saccharum Narenga* is included in this list. This of course is not a cane at all, being in fact a wild grass in India which does not form any cane, and is only distantly related to the sugar canes of North India. Merthi is a well known cane of the same class as Uba, but this is not the case with the other two mentioned, Khera and Kinar. The rest are apparently introduced from Brazil and Japan or China, and we have no knowledge of their affinities. A real test of the hundreds of indigenous Indian canes is much to be desired, in view of the fact that a case of mosaic has been found in that country. The Table shows that, while Merthi and Kinar were not attacked, Khera and the wild grass Narenga were.

The last experiments noted in this interesting series were those to determine definitely whether sugar cane mosaic can be transmitted by seed. The results

with maize, Sorghum and certain wild grasses were all of them negative, seedlings from diseased parents being invariably healthy. This is in agreement with the results obtained by workers in Java on sugar cane mosaic, and those obtained in the allied disease of the tobacco.

ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE IN JAMAICA FOR THE YEAR ENDED DECEMBER, 1922.

The paragraphs dealing with the sugar industry generally in this Report were referred to in a recent number of this Journal (p. 450), and the following notes on agriculture are added here. The Director reports that the mosaic disease is spreading in the fields, especially in places where remedial measures have been neglected owing to the demoralization of the industry during the past two seasons. The Uba cane continues its successful career, especially as a fodder crop. At the Hope Gardens 102 tons per acre of canes were produced, and it is claimed that a yield of fodder of this quantity, containing as it does 12 per cent. of sugar, is a first class crop, comparing favourably with the best returns from mangels in the United States or Great Britain. The planting of Uba for sugar making is also extending where mosaic is prevalent and where for any other reason the old varieties are unsuccessful. Owing to the enormous growth of these canes, which reach 20 ft. in length, it is suggested that Uba should be planted in rows at least 6 ft. apart, as by this means thicker and fewer canes will naturally result. The distribution of tops during the year constituted a new record of 426,449, or more than double the number disposed of in the preceding year (in itself a record we believe). Presumably the great bulk of these tops were, as in that case, of the Uba variety.

The manurial experiments were carried out on the stereotyped lines, nitrate of soda, sulphate of ammonia and sulphate of potash being applied either singly or in conjunction with one another or with the local pen manure, lime or ashes which were also applied separately. Phosphates were as usual left out, in that in past years no favourable results had been obtained by their application. The results of the application of the manures on the various estates selected for the experiments are given in some detail, and it is obvious from these that no general rules can be laid down for the whole island. This will be seen from the following extracts. At Long Pond the best results were obtained with potash, ashes and pen manure: at Georgia, where the soil is light and marly, nitrate of soda was most successful: at Swanswick sulphate of ammonia or nitrolim gave good returns, while the response to pen manure was instantaneous. In Orange Valley and Catherine Hall nitrate of soda gave better results than sulphate of ammonia, while at Worthy Park in five localities ammonium sulphate was found superior: at Amity Hall, Pusey Hall and Sweet River either or both together gave equal results, while in the two former estates lime was also useful and in the last one potash.

Various attempts were made to raise seedling canes, by means of crossing different parents. Uba having flowered, it was made use of as a male parent, but we were under the impression that this cane is usually male sterile. The other varieties were White Transparent, D 117, B 295, B 6450 and B 7924. The dry hot weather was apparently against the germination of the seedlings in the open, but better results were obtained under glass. The Entomologist states that no reports were received regarding invasions of insect pests during the year. We note, on comparing the list of staff with that in the previous year, that several additions have been made: a Microbiologist and a Deputy Island Chemist joined the staff in November, and a Superintending Inspector and three Inspectors of Plant Diseases were appointed.

C.A.B.

British West Indies.

(Colonial Office Reports).

ANTIGUA.

In Antigua the year 1921 was, from an agricultural point of view, less satisfactory than the preceding one. This was due to the low rainfall experienced during the growing months of 1920. The average rainfall for the calendar year was 30·32 in., or 0·23 in. more than that of 1920. The labour supply was satisfactory though still limited.

In the annual report of the Antigua Sugar Factory for 1921 it is shown that the number of tons made was 8949, as against 10,638 in 1920, and that the total receipts from sugar and molasses were £228,388, as against £401,218 in 1920. The total expenditure was £210,601, a surplus of £17,788 being thus left for distribution. The average sales price of the sugar manufactured was £26 per ton, and one ton of sugar was obtained from 8·95 tons of cane. Bendals' Sugar Factory manufactured 1516 tons of sugar, equal to one ton of sugar from 11·05 tons of cane. The average sales price of the sugar manufactured was £20 per ton, and the expenditure exceeded the revenue by £10,424.

ST. KITTS.

Owing to the unfavourable weather conditions of 1920 the sugar crop of 1921 was far below the average, the total export of sugar, equating syrup to muscovado, being 10,592 tons, a decrease of 1891 tons on that for the previous year. Of this total 7885 tons of crystals, 1648 tons less than in 1920, were produced by the St. Kitts (Basseterre) Sugar Factory.

The good prospects as regards prices with which the year opened were not fulfilled, the export value of the total crop being £267,449 as against £506,947 in 1920. The sudden and heavy fall in prices seriously affected the financial position and value of estates. The crisis had to be met towards the end of the year by reduction in wages, which was mitigated by decrease in the price of foodstuffs and was accepted as unavoidable and without trouble.

The weather conditions for the crop to be reaped in 1922 were very unfavourable, the rainfall for 1921, 42 inches, being far below the average.

ST. LUCIA.

Four Central sugar factories—Cul de Sac, Roseau, Dennery and Vieux Fort—were working during the year 1922. Notwithstanding that the price of sugar remained about the same as that of the previous year, local conditions, particularly as regards labour, were more satisfactory, thus enabling more work to be done at the factories, and resulting in a better output. In addition to the sugar consumed in the Island, the quantity exported amounted to 4016 tons, as compared with 3238 tons in 1921. The output of the rum distilleries also showed an increase, 54,484 proof gallons being manufactured, as against 51,385 gallons in 1921.

The Imperial College of Tropical Agriculture, Trinidad, is gradually completing its professorial staff. The latest appointment is that of the Demonstrator in Chemistry, which has been awarded to Mr. PERCIVAL ELISHA TURNER, B.Sc., A.I.C., recently Demonstrator in Chemistry to Intermediate Science Classes at University College, Reading. Mr. TURNER was educated at the latter college, and took the London Pass B.Sc. in Physics and Pure Mathemathics and the Honours B.Sc. (Second Class) in 1921 for Chemistry. During his Demonstratorship he took part in research work. At present he is undergoing a three months' intensive course of study in Agricultural Chemistry at Rothamsted before proceeding to his new appointment.

Publications Received.

A Textbook of Filtration. By Charles L. Bryden, B.S., and George D. Dickey, B.S. With 264 illustrations in the text. (The Chemical Publishing Co., Easton, Pa., U.S.A.) 1923. Price: 27s. 6d. net.

During recent years a great deal of work has been done on filtration, and many new filters have been developed for special purposes, yet the books on the subject in the English language are few, though it is true that a great number of articles and pamphlets have been published. Bühler's well-known work on the subject served well as a comprehensive description of the principal types of apparatus in general use; but filtration is now a subject of such importance that there is certainly need for a really scientific textbook giving the fundamental principles underlying the practice of this branch of chemical engineering. This volume by Messrs. BRYDEN and DICKEY has been written with this end in view, the attempt having been made to collect in one cover the most valuable, theoretical and practical information relating to the art. In regard to the theoretical part, there is a very fair statement of what is now known of the influence on the rate of flow of the filtrate of the structure, shape, and nature of the particles of the residuum under treatment, and of the size and shape of the pores of the filter medium. But in the main the book is devoted to the principles and construction of a very wide range of apparatus, viz., water filters; air, gas, and light filter; hydraulic apparatus; oil filters and extractors; plate-and-frame presses; leaf filters; rotary filters: while there is a section also on centrifugal filters. In these chapters the numerous apparatus are clearly described and illustrated, and here and there the results of the author's experience with certain types is stated. There are four supplementary chapters on coagulants and filter aids, filter media, operating data and care of apparatus and useful general data on filtration, and these greatly add to the value of the book, in that they summarize a good deal of information which so far has not been collated from the facts stated in numerous articles and pamphlets. This volume forms a very useful addition to the literature of industrial filtration, and the sugar factory and refinery engineer will find much in it to interest him.

The Phase Rule. A. C. D. Rivett, M.A., D.Sc. (Clarendon Press, Oxford.) 1923. Price: 10s. 6d. net.

This is an elementary textbook for the use of the student of the study of heterogeneous equilibria from the standpoint of the Phase Rule and the Principle of LE CHATELIER and BRAUN. It discusses types of systems which may be met, and ways in which such systems may graphically be represented, also giving some examples of the manner in which conclusions of practical importance may be deduced. In view of the attention that is being given by certain workers to the question of the theory of the formation of molasses from the standpoint of the Phase Rule, Mr. Rivett's small book should be found of value. It forms a very suitable introduction for the use of those desirous of following this line of investigation.

Report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1922-23 (dealing *inter alia* **with Progress in the Production of Power Alcohol**). (H.M. Stationery Office, Kingsway, London, W.C. 2.) Price: 4s. 2d. post free.

An account is given of experiments which have been conducted for carrying out the acid hydrolysis of cellulosic materials. It is said that the mechanism is now well established for ensuring the maximum production of pentoses with a very low strength of acid at a moderate temperature and pressure. Fermentation of the pentoses by means of *Bacillus acetoethylicum anthrop* has been the subject of a number of laboratory and semi-technical experiments with wheat straw and African grasses. A Memorandum (No. 2) on the question of fuel for motor transport was circulated to the Dominions and Colonies in 1921, requesting certain information on the present position and possibilities of the project, and a summary of the reports received together with information obtained from other sources is here given.

The Mauritius Almanac and Commercial Handbook for 1923-4. Compiled by A. Walter, F.R.A.S. (The General Printing & Stationery Co., Ltd., Port Louis, Mauritius.) 1923. Price: Rs. 10.

This almanac and handbook contains a great amount of information relating to the Island of Mauritius, its administration, social activities, finances, trade conditions, agriculture, Government Departments, tariffs, and laws. It gives evidence of the resources, fertility, and enterprise of the planting and commercial community of this small Colony. Its compilation reflects much credit on its Editor, Mr. WALTER, who collates his data with considerable skill.

Electrical Handling of Materials. H. H. Broughton. (D. Van Nostrand Company, New York.) 1923. $12.50.

This is a manual in four volumes on the design, construction, and application of cranes, conveyors, hoists, and elevators. Volume IV deals with the machinery used for the mechanical handling of materials, and the methods of handling and storing them.

Trinidad Cane Farming and Sugar Crop Returns, 1923.

Below are the annual figures of the Trinidad 1923 sugar crop, as compiled by Messrs. Edgar Tripp & Co. It is one of the lowest registered during the past 25 years, there having been only two years in that period when the crop was less, viz., in 1912 (40,436 tons) and in 1905 (38,240 tons). This meagre crop comes as a disappointment just at a time when the general improvement in prices in both the United Kingdom and the United States would have made a bumper crop a financial boon to the island sugar industry.

ESTATE.	Total Sugar made Tons.	Tons of Sugar made from Estate Cane.	Tons of Estate Cane Ground.	Tons of Cane Purchased.	Amount paid for Canes. $	NO. OF FARMERS. East Indian.	West Indian.
Brechin Castle	3,328	2,643	27,215	7,376	39,113·00	415	326
Bronte	2,542	1,293	13,132	14,181	41,973·04	644	172
Caroni Estate	4,056	*2,967	41,524	15,270	54,972·00	962	614
Craignish	606	203	2,439	5,772	22,516·58	720	380
Esperanza	2,210	1,514	16,844	8,021	‡	488	293
Forres Park	1,737	1,174	12,674	6,752	24,311·65	408	143
Hindustan	384	41	656	5,358	19,985 04	252	587
Reform	494	‡	—	6,497	23,232·22	‡	‡
Tacarigua Factory	3,020	1,312	14,022	18,052	† 88,757·28	749	773
Usine Ste. Madeleine	13,732	7,925	74,891	53,938	†156,279·98	3,077	1,952
Waterloo Estates	5,210	*2,829	30,042	25,733	† 92,638·80	1,105	1,010
Woodford Lodge	4,300	2,350	19,772	19,495	101,568·95	850	580
Total, 1923	41,619	24,251	253,211	186,445	665,378·54	9,670	6,830
Return for 1922	59,948	29,599	340,358	355,364	813,036	12,605	8,745
,, 1921	54,933	24,207	286,974	389,399	1,773,227	15,046	11,379
,, 1920	58,416	28,953	319,421	344,226	2,924,404	14,536	10,824
,, 1919	47,850	24,656	275,451	270,324	1,210,155	12,370	8,568
,, 1918	45,256	22,544	252,783	266,144	812,247	12,158	8,244
,, 1917	70,891	36,102	378,999	384,650	1,093,770	12,055	8,984
,, 1916	64,231	35,653	426,106	363,775	1,008,665	14,014	8,212
,, 1915	58,582	34,376	426,262	325,071	869,790	9,202	7,078
,, 1914	55,488	35,690	407,797	201,799	486,630	7,450	5,253

* Estimated. † Paid on account.

Review of Current Technical Literature.[1]

De Haan's Carbonatation Process of clarifying Cane and Beet Juices.
H. A. C. Van der Jagt. *Chemisch Weekblad, 1923, No. 1007, 9-15.*

In De Haan's process,[2] which has now almost displaced ordinary carbonatation in Java, liming and carbonating are carried out simultaneously, the procedure being to run a stream of milk-of-lime into the raw mill juice heated to 50–55°C., turn on the gas at the same time, and subsequently so to regulate the proportions of the two reagents that the alkalinity during the entire operation does not exceed 0·3 grm. of CaO per litre, which limit is conveniently controlled by the use of Dupont paper having the stated degree of alkalinity. In this article Mr. Van der Jagt discusses the application of this modification to the clarification of beet juices in Holland, in comparison with ordinary carbonatation, the following six experiments having been carried out in the laboratory, using of course the same beet juice in all: (1) One litre of the juice was heated to 80°C., 18 grms. of powdered lime added in one portion, and the mixture stirred during 15 mins. at the temperature stated and carbonated to slight alkalinity to phenolphthalein paper, which is the ordinary carbonatation process, as operated in Dutch beet factories. (2) As in the previous test, but using 16 grms of CaO, and operating double carbonatation. (3) One litre of the juice was heated to 80°C., 18 grms. of lime in the form of milk added in small amounts, and CO_2 passed in at the time, that is, De Haan's single carbonatation process, using, however, a higher temperature than in the case of the glucose-containing cane juice. (4) As in the previous test, but using a still higher temperature, viz., 90°C. (5) As in the third test, but followed by a second treatment, that is, De Haan's double carbonatation. (6) As in the previous test, that is, De Haan's double carbonatation, but using 16 grms. of CaO. Here are the results obtained, S C. and D.S. indicating single and double carbonatation respectively:—

		(1) S C. Ordinary at 80°C.	(2) D C. Ordinary at 80°C.	(3) S C. de Haan at 80°C.	(4) S.C. de Haan at 90°C.	(5) D C de Haan at 80°C.	(6) D C. de Haan at 80°C.
Brix	16·42	17·01	17·23	16·97	18·89	17·30	17·31
Sucrose	14·71	15·81	16 05	15·83	17·75	16·10	16·15
Purity	89·59	92·94	93·15	93·28	93 97	93·07	93·30
Ash factor[3]	2·62	2·30	2·60	1·97	2·16	2·26	2·14
CaO factor[4]	0·121	0·237	0·326	0 078	0·125	0·098	0·075

These laboratory figures would therefore show that De Haan's process, either single or double, when applied to the clarification of beet juices, gives better results than ordinary carbonatation, as is shown by the marked reduction of the ash and CaO factors, and also by a somewhat higher purity value throughout; and, further, that De Haan's single carbonatation gives rather better results than the double carbonatation, which is contrary to what De Haan himself has found in small-scale tests in Java,[5] though Harloff, on the ground of both laboratory and factory experiments, declared himself in favour of the single operation.[6] Coming now to consider the optimum temperature for the De Haan process, it was hoped by using 90°C., while keeping the alkalinity low all the time, as prescribed by De Haan, to obtain a more effective elimination of the non-sugars; but on comparing the results of Tests 3 and 4 in respect of the ash and CaO factors, it will be seen that this was not so, though it is true that the purity value was somewhat higher when working at 90°C. It was noticeable, however, that the colour of the juice resulting from the De Haan clarification at 90°C. was much darker. In fact, from this series of experiments, and from another carried out later, it would appear that, while De Haan's process removes more non-sugars than ordinary carbonatation, the colour of the resulting juice is not quite so good, though the author considers that a well-controlled

[2] See *I.S.J*, 1914, 131; also U.S. Patent, 1,101,071; *I.S.J.*, 1914, 438. [3] Ash per 100 of sucrose. [4] CaO per 100 of sucrose. [5] *Archief.* 1917, 501. [6] *Ibid.*, 1911, 783.

thin-juice sulphitation, by which sulphites are formed, should be capable of correcting this sufficiently. Discussing De Haan's process in a general way, it is pointed out that frothing, which often causes such trouble in ordinary carbonatation, owing to the formation of the viscous double compound of calcium saccharate and calcium carbonate, is obviated. Furthermore, it would appear from Java practice that 40 per cent. less lime is required, as compared with ordinary carbonatation, which is certainly another great advantage, this being attributed to the more adsorbent nature of the precipitate of $CaCO_3$ obtained by this interesting method of simultaneously liming and carbonating. A 1 : 10 scale drawing of a tank for carbonatation according to De Haan is reproduced. In operating this process, the density of the milk-of-lime prescribed is rather high, viz , 20° Bé. ; but, since such a mixture generally contains a good number of solid particles of lime, the result is a certain amount of glucose decomposition, which might be avoided with the use of a thin, well-slaked milk. As dilution with water would lower too much the density of the resulting clarified juice, it has been proposed in Java factories to thin the heavy milk with cold juice, this mixture being added to the carbonatation tank without much delay. Lastly, mention may be made of some experiments here described on the heating of alkaline solutions of invert sugar, to some of which a solution of potassium sulphite had been added. An alkaline solution of invert sugar which had been heated in a boiling water-bath showed a loss of 19 per cent. of the "glucose" originally present, and was dark-brown in colour; whereas one containing the same amount of invert sugar, and of alkali, but in addition some K_2SO_3 solution showed a loss of 25·9 per cent. when heated under exactly the same conditions, while its colour was only yellow. This result leads to the remark that: "The action of sulphites, as K_2SO_3, on alkaline-reacting solutions of glucose is misleading, since the lighter colour of the juice after the heating might induce one to suspect that the decomposition had been restricted to a minimum, whereas actually this is in no wise the case," in fact, it is added, the decomposition may be greater, since the K_2SO_3 and Na_2SO_3 in solution dissociate into OH-ions.

Increasing the Amount of Lime used for Clarification at the Pioneer Mill, T. H. *Herbert Walker.* *Reports of the Association of Hawaiian Sugar Technologists, First Annual Meeting, November, 1922.*

Formerly at the Pioneer Mill, T H., the cold juice was limed until it was just alkaline to litmus, the object in view being to produce approximately neutral clarified juice; but at the suggestion of Mr. McAllep, of the Experiment Station, the addition of lime has been gradually increased until the cold juice was decidedly alkaline to litmus, though still acid to phenolphthalein. Actually the liming is conducted so as to make the cold raw juice slightly alkaline to phenolphthalein, this giving a clarified juice still acid to the indicator just named. Five grms. of the phenolphthalein are dissolved in 500 c.c. of denatured alcohol, made up to 1000 c.c. with water, and sodium hydroxide solution added until a permanent pink colour appears. The man at the liming station fills a porcelain casserole with cold limed juice, pours it out again, and to the few drops remaining he adds a drop of the indicator, the proper degree of liming being indicated when a distinct but not excessive pink colour is imparted to the liquid in the bottom of the dish, which method of testing is considered to be more satisfactory than trying to observe the colour in a test-tube or on phenolphthalein paper. Regarding the result of increasing the lime in this way, it was found that the gain in purity is comparatively small (being 1·25, 0·89, and 1·24 for 0·0586, 0·0446 and 0·0628 of lime per cent. on the cane), but its effect on the recovery of sugar is about equivalent to a reduction in purity of 1° in the final molasses. No trouble has been experienced from the formation of excessive scale in the evaporator, nor has there been any difficulty in boiling either commercial or low-grade massecuites; while the undetermined losses are considerably lower than usual, being 0·56 per cent. sucrose in the cane to date. But there are some disadvantages. Greater settling tank capacity is required, owing to the larger amount of precipitate, and there were complaints from the mud-press men of more juice going along to their station along with the mud than was formerly the case. Further, it seems to be a little more difficult to get a

low purity final molasses. On the whole, however, it is considered that the advantages of the extra addition of lime outweigh the disadvantages, and the method will be continued. If the undetermined losses continue to decrease, the gain in total recovery will more than offset any increased filter-press and molasses losses.

Testing the Value of Decolorizing Carbon and Char. *Marshall T. Sanders.*[1] *Industrial and Engineering Chemistry*, *1923*, *15*, *No. 8*, *784-786.*

Four graphs, illustrating the fact that the removal of colour from solution by decolorizing carbon follows the Freundlich adsorption equation,[2] are presented. *Graph No. 1* shows the relation between the percentage of colour removed from a certain molasses solution and the weight of the carbon used, a curve being obtained, by which it is seen that 2 grms. of the carbon examined did not remove anything like twice the amount of colour taken up by the 1 grm. *Graph No. 2* is a plot of log X/M against log C of the Freundlich equation, X/M being the amount of colour adsorbed by a given weight of carbon, and C the concentration of the solute at equilibrium. Here an approximately straight line is obtained, from which the conclusion is drawn that in this particular case counter-current methods would reduce the amount of carbon consumed by a given quantity of solution. *Graph No. 3* is obtained also by plotting log X/M and log C in the case of two different carbons, A and B, two straight lines crossing one another being obtained, and shows that in the case of these particular preparations A would be superior to B weight for weight for high degrees of decolorization, but inferior for low degrees. Here A would be chosen if a high degree of decolorization were desired in one application of the carbon, while B would be superior for counter-current work. *Graph No. 4* shows Y/Z (fractions of colour removed divided by the grms. of carbon used) as compared with $1-Y$ (fractions of colour remaining). Consideration of these logarithmic plots shows the fallacies of certain methods of testing carbons, as, e.g., when a certain weight of the carbon under examination is used to treat molasses solution, and the decolorized solution is matched with samples prepared by the use of a standard carbon, the relative weights of the sample and of the standard carbon used to obtain the same degree of decolorization being taken as a measure of the efficiency of the sample. This method assumes the adsorption curves of the two carbons are parallel, which may not be the case; while, moreover, only one point of the curve is determined. The term "decolorizing power" is misleading, as it is generally determined for only one weight of the carbon under certain set conditions, which is equivalent to determining one point on the curve without telling anything of its direction. To say that a carbon is 20 times as efficient as another is equally valueless, since the relative efficiencies of two carbons may vary with different solutions, and even with different initial concentrations of the same solute and solvent. Lastly, the author describes his procedure for plotting out X/M and C on so-called double logarithmic paper, and of calculating the "degree of decolorization."

Production of Insulating Lumber ("Celotex" Building Boarding and Box Material) from Bagasse. *Alan G. Wikoff.* *Chemical and Metallurgical Engineering*, *1923*, *29*, *No. 9*, *360-362.*

An illustrated description of the "Celotex" plant at Marrero, on the Mississippi River, near New Orleans, is given.[3] Entering the mill, the bagasse bales are opened and fed by conveyor through a shredder to the cooker, in which the resins, waxes, and similar constituents are removed, leaving the fibres tough and flexible As in the case of ordinary paper, fibre separation is obtained by treatment in beaters and refiners. Waterproofing material is added at this stage and the pulp pumped to storage tanks, which feeds a machine felting the fibres into a continuous board 12 ft. wide, which board is formed in one operation, and is not built up of separate layers. Passage through a 800 ft. continuous hot air dryer removes absorbed water, and all that remains to be done is to cut the board by means of cross-cut and rip saws into standard 4 ft. widths, the length varying

[1] Atlas Powder Co., Wilmington, Del., U.S.A. [2] See *I.S.J.*, 1923, 327.
[3] See also *I.S.J.*, 1921, 641; 1922, 325.

from 8 to 12 ft. as desired. From 25 to 30 million sq. ft. of board is produced annually by the present plant, and this capacity will be greatly increased by additions now under construction. Two general classes of board are made, a $\frac{7}{16}$ in. building board, and a $\frac{5}{16}$ in. box material. "Celotex" insulating lumber has an apparent specific gravity of 0·25 and weighs only 60 lbs. per 100 sq. ft when $\frac{7}{16}$ in. thick, so that it contains 80 to 85 per cent. of voids. Owing to the interweaving and felting of the fibres, a very large proportion of this air space is in the form of dead air cells, which are most efficient heat insulators. In insulating value "Celotex" is equal to cork, the thermal conductivity determined by the flat plate method being 7·91 B.T.U. per sq. ft. of surface per deg. F. difference in temperature per 24 hours for 1 in. thickness, Bureau of Standards values for other materials expressed in the same unit being: corkboard, 7·4; rock cork, 8·3; pulp board, 10·4; and white pine, 19. Notwithstanding its light weight, the lumber is very tough and strong, its tensile strength averaging 373 lbs. per sq. in. As regards transverse strength, a board 6 in. wide with supports 12 in. apart showed a deflection of $\frac{1}{4}$ in. under a load of 32 lbs., while 158 lbs. applied to a 12 in. board with supports 16 in. apart produced a deflection of $\frac{1}{16}$ in. Tested as a sheathing material applied to studs, in comparison with sheathing of $\frac{7}{8} \times 6$ in. yellow pine, "Celotex" showed six times as much resistance at the point of initial deflection and nearly twice as much load at the point of failure. Under compression the material merely becomes more compact and does not exhibit any maximum crushing strength. Thus a pressure of 1,800,000 lbs. per sq. ft. produces an 80·52 per cent. reduction in thickness under load and a permanent reduction after releasing load of 72·90 per cent. Water absorption tests show an absorption of 3 per cent. by volume after four hours' immersion and 12 per cent. at the end of 72 hours. "Celotex" can be cut and sawed like ordinary lumber. It finds use for roofing, the exterior finish for plant offices and the like, for the construction of refrigerator cars, cold storage warehouses, etc., etc.

RECOVERY OF POTASH FROM WASTE MOLASSES. *Raymond Elliott. Reports of the Association of Hawaiian Sugar Technologists, First Annual Meeting, November, 1922.*

Molasses was burnt at Paauhau during 1922 for the recovery of the ash and the potash in the ash, a specially constructed furnace being used into which the molasses was fed in the form of a thick spray. An analysis of the ash by the H.S.P.A. Experiment Station gave the following as the average composition of the product of three months' run:—

	PER CENT.
Potash	27·66
Silica	3·63
Iron and aluminium oxides	1·22
Lime	17·67
Phosphoric acid (P_2O_5), soluble in acid	2·00
,, ,, ,, water	trace
Sulphuric acid (SO_3)	8·36
Carbonic acid (CO_2)	5·39
Chlorine	16·49
Carbon	11·79
Total solids, soluble in water	55·28

During the three months' run, the ash recovered per cent. of that present in the molasses originally rose from 41·37 to 87·96 per cent.; while the potash recovered, per cent. of that in the molasses increased from 32·89 to 73·48 per cent. This rise in the recovery is attributed to the improvement of the operating conditions in respect of draught and temperature, the best recovery being obtained with a draught not exceeding 0·10 in., and a temperature just sufficient to effect the combustion of the molasses. This is readily explicable by the fact that at relatively high temperatures, potassium chloride (in which form most of the potash was present) is volatilized, a fact which is borne out by the low potash content of the ash when the ash recovery is also low.

Review of Current Technical Literature.

USE OF AN ASH/SUCROSE FORMULA FOR THE CALCULATION OF THE SUCROSE RECOVERY. *Raymond Elliott and J. C. Chapman. Facts about Sugar, 1922 14, 310.*

Calculations of the recovery, based on the ash/sucrose ratio (ash per unit of sucrose = A/S) were made during a period of six weeks at the Paauhau mill, T. H., using the formula: $\frac{\text{A/S molasses} - \text{A/S juice}}{\text{A/S molasses} - \text{A/S sugar}}$, and the results obtained compared with those given by the *S J M* formula. These formulae were applied to the syrup, and also to the raw juice. Since, however, mineral matter is added to the mixed juice in the form of lime, and since a large quantity is removed in the press cake, this necessitated a correction for the sulphated ash value of the lime, and a determination of the ash in the press cake. Due to the fact that the press cake is not weighed, and to the varying ash equivalent of the lime, the results are perhaps open to criticism. Nevertheless, the figures indicating the results are consistent, and are closer to the actual values than are either the *S J M* or the A/S as applied to the syrup, as the following tabulation shows:

	A/S Recovery on mixed juice.	A/S Recovery on the syrup.	*S J M* Recovery.	Actual Recovery.
1st week	—	90·49	91·08	—
2nd "	—	90·10	91·02	—
3rd "	89·90	90 66	90·76	—
4th "	90·40	91·24	90·86	—
5th "	90·69	91·25	91·93	—
6th "	90·83	91·53	91·66	—
Average	90·27	91·00	91·28	89·91

It would appear from the above results that the yield calculated by the A/S formula checks very well with that calculated by the *S J M* formula, especially when based on the syrup. But the use of mixed juice in this connexion entails two extra ash determinations, and a rather involved calculation. In a mill in which the remelted low sugars are not returned to process ahead of the evaporators, there is no advantage in using the mixed juice for the calculation of the results. In such a case syrup is the proper material to use.

APPRAISING THE WORK OF THE DIFFUSION BATTERY IN THE EXTRACTION OF SUGAR FROM THE BEET. *A. P. Sokolow. Zeitsch. Zuckerind. czecho-slov. Republik, 1923, 47, 667–670, 703–706, 711–714.*

Examination of the exhausted pulp and of the wash-waters cannot afford a proper indication of the efficiency of the working of the diffusion battery, which can only be obtained by considering the operation of each diffuser separately and of the whole number of them collectively. There is no relationship between the sugar lost in the diffusion process, the purity of the wash-water, and the purity of the final molasses of the factory, upon which one can base any working figure to serve for the purpose of control; and a reliable idea of the efficiency of the operation of the various effects during the process of extraction can be deduced only from the examination of the juice contained in the several vessels. Battut's curves[1] showing the increase of sugar and non-sugar from diffuser to diffuser serve this purpose well; and, moreover, by a study of them it is possible to obtain an indication of the extent of the permissible loss during the working of the process of extraction. Such curves, with sugar and non-sugar increases as ordinates, and the number of the vessel as abscissæ, have been constructed by the author from figures obtained by taking samples of juice from each diffuser and examining them for sucrose content and purity. In the case of the sugar, the curves show a gradual rise until the 10th vessel is reached, but in that of non-sugar the graph is rather erratic in character throughout.

J. P. O.

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[1] *Sucrerie Indigène,* 1886, 27, 414.

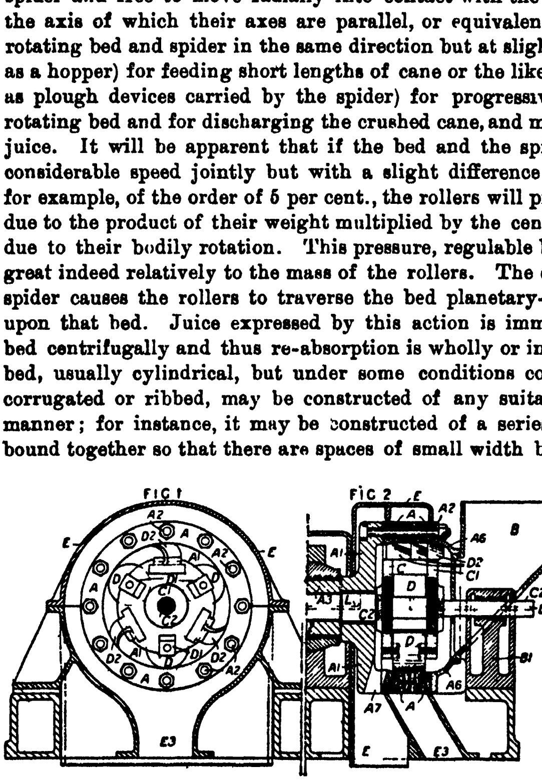
Review of Recent Patents.[1]

UNITED KINGDOM.

CANE CRUSHING APPARATUS. *Duncan Stewart & Co., Ltd.*, of London Road Iron Works, Glasgow, Scotland (communicated by *Wilhelm Mauss*, of Johannesburg, Natal, Union of South Africa). *201,823*. October 27th, 1922.

A novel type of apparatus for the crushing of cane for the extraction of its juice is provided in this invention, in which the pressure necessary for the crushing of the cane is provided by the action of centrifugal force, which also acts to instantly discharge the exuded juice and prevent or minimize its re-absorption. An apparatus made according to the invention comprises essentially a rotatable and preferably cylindrical permeable bed, a spider or equivalent co-axial with the rotatory bed, a series of rollers carried by the spider and free to move radially into contact with the internal surface of the bed (with the axis of which their axes are parallel, or equivalently placed to parallel), means for rotating bed and spider in the same direction but at slightly different speeds, means (such as a hopper) for feeding short lengths of cane or the like to the rotating bed, means (such as plough devices carried by the spider) for progressively feeding the cane across the rotating bed and for discharging the crushed cane, and means for collecting the discharged juice. It will be apparent that if the bed and the spider with its rollers are rotated at considerable speed jointly but with a slight difference between their rates, a difference, for example, of the order of 5 per cent., the rollers will press upon the bed with a pressure due to the product of their weight multiplied by the centrifugal force acting upon them, due to their bodily rotation. This pressure, regulable by variation of the speed, is very great indeed relatively to the mass of the rollers. The differential movement of bed and spider causes the rollers to traverse the bed planetary-wise and thus crush the cane fed upon that bed. Juice expressed by this action is immediately thrown out through the bed centrifugally and thus re-absorption is wholly or in large part avoided. The rotary bed, usually cylindrical, but under some conditions conical, or for instance internally corrugated or ribbed, may be constructed of any suitable material in any convenient manner; for instance, it may be constructed of a series of rings of deep radial section bound together so that there are spaces of small width between, or bars may be similarly arranged in axial direction. The bed may be supported and driven in any convenient manner. The rollers may be carried in or from the spider in any convenient manner; for example, there may be radial guides in the spider in which bearing blocks carrying the rollers are free to slide. It is apparent that these and other structural details may be varied widely.

FIG 1 FIG 2



In this example here illustrated, the permeable bed consists of a series of rings A bolted to one another (with a small and outwardly increasing clearance) and to a massive rotatory carrier disc A^1 by bolts A^2. The carrier disc, extended in the form of a sleeve A^8, is supported in bearings. A lip piece A^6, held also by the bolts A^2, makes joint with a face on a hopper B which is supported on a pedestal B^1. The spider carrying the rollers consists of two discs C, C^1, mounted on a shaft C^2 passing through the sleeve A^8, carried in external bearings and in the pedestal B^1. The rollers D, of which there are three, are mounted on spindles having on them blocks D^1 which slide in radial guides in the discs. Mounted on the spider, intermediately to the rollers, are three series of plough

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

devices D^2. A casing E encloses the bed and its parts, and has an inward lip making joint with it. There are provided in the disc A^1 a series of apertures A^7 for the discharge of spent cane to one side of this lip and to a discharge aperture E^2. The juice finds its way through the bed to the space in the casing E on the other side of the lip E^1 and so to a discharge aperture E^3. Driving, in the arrangement shown, is by means of belt gearing from a lay shaft driven by belt gearing from the shaft C^2, the initial drive being to the spider C, C^1, by way of the shaft C^2, on which are fast and loose pulleys. In action the cane, cut into short lengths, is fed to the hopper B, and passes thence through an aperture to the rotating elements, where it is seized by the ploughs D^2 and drawn on to the rotating bed to be crushed by the rollers. The ploughs gradually work the cane across the bed until it is discharged by them at the inner end whence it finds its way to the outlet. Meanwhile centrifugal force, developed by the rapid rotation of the whole, has caused the expressed juice to be immediately thrown out through the permeable bed to the discharge outlet. Wash or maceration water may be introduced by way of an inlet L.

Film Evaporator of the Lillie Type. *S. M. Lillie*, of Springfield Avenue, Philadelphia, U.S.A. *201,134*. February 13th, 1923.

In evaporators of the kind in which liquid is showered over a nest *8* of heated tubes, the nest is mounted in a surrounding casing *1* so as to leave vapour passages *10, 11*, at the sides, and a chamber *12* above the nest for separating entrained water. Unevaporated liquid collecting in the base *9* is withdrawn by a pump *7* and is returned by a pipe *26* discharging on to a perforated plate *21* covering the nest *8*. The heating-tubes open at one end into a steam-chamber *14* and at the other one, either closed except for a small air vent, or open into a floating header which is vented into the evaporator casing or through a pipe extending through the nest and through the steam chamber *14*. Baffles *24*, *24a*, consisting of two parallel rows of vertical I-bars arranged in staggered relation are supported by bars *26*, *27*, *28*, between the tube nest and the side passages *10, 11*, and between these passages and the settling-chamber *12*. The nest of tubes may be heated by hot gases or by electricity.

FIG 1.

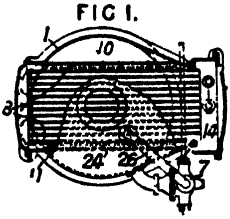
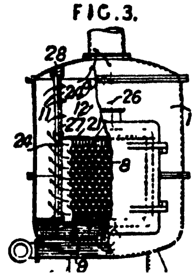


FIG.3.



Carbonatation of Saccharate Solutions. *Colorado Iron Works Co.*, of Denver, Col., U.S.A. *197,978*. November 23rd, 1921.

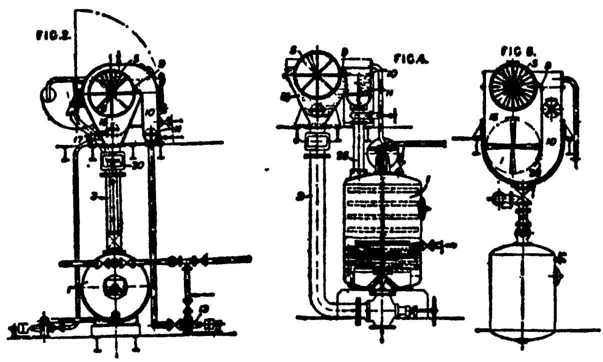
Apparatus is described for securing intimate contact of liquids with gases, which may be used in connexion with the carbonating of a saccharate solution, as well as for a variety of other purposes. It comprises a rotor having spiral vanes, which rotates in a chamber containing liquid and draws gases and liquid towards its axis, and discharges them axially into liquid in an adjoining chamber through a cylindrical screen, mounted concentrically on and rotating with the rotor shaft, and extending laterally from the rotor across the discharge chamber.

Furnaces (for burning Damp Fuel). *Babcock & Wilcox, Ltd.*, of London (*Deutsche Babcock & Wilcox Dampfkesselwerke A.-G.*, of Oberhausen, Germany.) *200,722*. August 8th, 1922.

In furnaces for burning damp materials, the fuel is dried and pre-heated on an extension of the chain grate before entering the combustion chamber proper, using gases drawn from the hottest part of the fire through damper-controlled passages in the arch, which gases are passed downwards through the raw fuel by means of a suction draught applied under the chain grate.

PURIFYING LIQUIDS (E.G., SYRUPS WITH DECOLORIZING CARBON). *Naamlooze Venootschap Algemeene Norit Maatschappij (General Norit Co., Ltd.)*, of 2, Den Texstraat, Amsterdam, Holland (Assignees of *J. N. A. Sauer*). *198,366*; addition to *163,505*. May 25th, 1923; convention date, May 26th, 1922.

The process described in the parent specification,[1] and in specification No. 172,962,[2] is modified in that during the mechanical separation of the purifying agent from the filter surface the pressure difference which drives the liquid through the filter is wholly or partly removed or a pressure is applied in the opposite direction. A rotary drum filter *5*, Fig. 2, may be used, the interior of the drum being divided into sector-shaped compartments which communicate, by means of longitudinal tubes in the hollow shaft *6* and a distributing valve, with a suction conduit and with conduits for the supply of compressed air and steam. Mixed liquid and purifying agent pass from the mixer *1* through a conduit *3* and valve *20* to the filter chamber *16*. The liquid is drawn through the filter to the suction conduit and the separated purifying agent is removed by a scraper *9* to a chamber *10*, from which it is returned to the mixer by a pump *13*. The filter compartments near the scraper *9* are in communication with the sources of compressed air and steam. The chambers *10*, *16*, are provided with agitators *11*, *17* In the arrangement shown in Fig. 4, the mixer *1* is vertical and the liquid for treatment is supplied to the chamber *10* where it is mixed with the purifying agent removed from the filter by the scraper, the mixture passing on through a conduit *25*, the mixer *1* and a conduit *3* to the filter chamber *16*. Fig. 6 shows an arrangement in which the filter chamber *16* and the chamber *10* are upper compartments of the mixing vessel, separated by a wall *28*. A thin layer of fresh purifying agent may be applied to the filter surface by means of a sprayer arranged below the scraper.



FILTERS. *P. Dehne*, of Freiburg, Germany. *195,083*. March 16th, 1923; convention date, March 17th, 1922. *196,901*. March 27th, 1923; convention date, April 25th, 1922.

Filters are described of the type in which the elements are suspended in a closed casing through the bottom of which they can be raised and lowered by a rod and piston.

ACTIVE (DECOLORIZING) CARBON. *Farbwerke vorm. Meister, Lucius & Brüning*, of Hoechst-on-Main. (*A*) *200,839*. July 16th, 1923; convention date, July 15th, 1922. (*B*) *201,163*. July 12th, 1923; convention date, July 22nd, 1922.

(*A*) Active charcoal is obtained by heating, in presence of an acid of phosphorus, carbonaceous material such as wood, turf, straw, brown coal or a mixture of these materials, in a revolving furnace, internally heated by combustion gases. The entry of air or of an excess of oxygen into the combustion gases may be permitted; and the presence of oxygen in the gases leaving the furnace is advantageous. (*B*) Active charcoal, "of a practical hardness and not too voluminous," is made from peat or lignite by mixing it with finely divided wood and carbonizing, with or without impregnation by a chemical reagent. In an example, peat is ground and mixed with sawdust and the mixture soaked with a solution of phosphoric acid. It is then compressed in moulds and carbonized, for instance, in a revolving kiln.

[1] I.S.J., 1921, 535. [2] I.S.J., 1922, 273.

PACKING LUMP OR CUBE SUGAR FOR USE AT TABLE. *Geoffrey Fairrie and Fairrie & Co., Ltd.*, of Liverpool. *199,176.* April 1st, 1922.

Two or more cubes or rectangular shaped pieces of sugar are placed together with their abutting ends transverse to the length of the packet to be made, and are wrapped in paper, the ends being secured by adhesive or otherwise. The packet is broken open by twisting the ends in opposite directions to rupture the paper at the abutting end of the pieces.

UNITED STATES.

APPARATUS FOR DRYING CHAR (ANIMAL CHARCOAL OR BONEBLACK) PREPARATORY TO REVIVIFICATION. *Henry E. Niese* (assignor to *The American Sugar Refining Co.*, of New York, U.S.A.). *1,452,166.* April 17th, 1923.

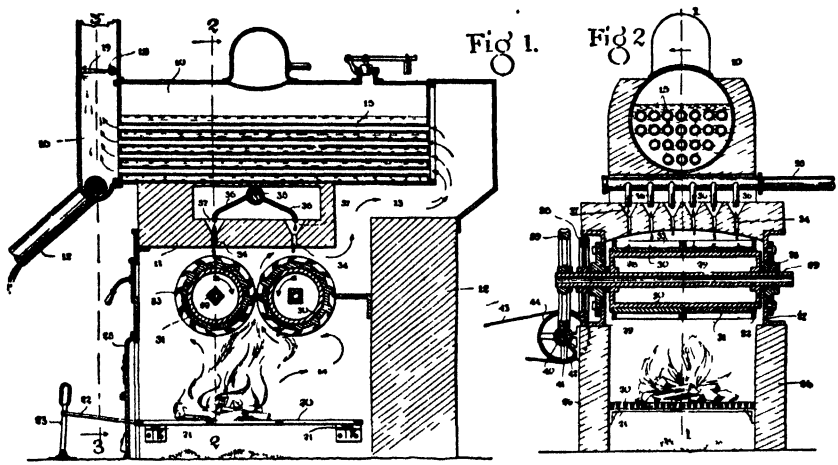
Drying apparatus adapted for use in conjunction with a char revivifying kiln preparatory to its being calcined in the retorts of the kiln has heretofore been devised wherein a heating chamber is provided through which hot gas, usually the waste products of combustion of the kiln, is circulated to dry the material, the material passing by gravity through a channel adjacent the heating chamber from an inlet opening near the top of the channel. In such devices, the hot gas is introduced near the bottom of the heating chamber where the gas at its highest temperature acts first to heat the dried material about to be discharged, and, subsequently, after being cooled by circulation through the chamber, reaches the upper portion thereof to heat the incoming material containing the most moisture. This objectionable feature is overcome in the present invention, which includes a downwardly extending passage for the material to be dried, an inlet opening for this passage, preferably near the top of the dryer, a passage for hot gas which is exterior to the passage for material, a heat-conducting partition between the passages having heating surfaces for the material, and means for supplying hot gas to the passage therefor, the latter passage being constructed and arranged to lead the hot gas first to the portion of the partition the heating surface of which is adjacent the inlet opening for the material, and then in a downward course preferably back and forth across the lower portions of the partition, substantially parallel to the descending column of material. The passage for the material and the hot gas may consist respectively of a chamber, and a flue for heating the chamber, which is exterior thereto, and the flue may have baffle plates therein spaced alternately from its opposite ends to lead the gas downwardly and back and forth through the flue. The invention comprehends as another of its parts the provision of means whereby a maximum of the material is subjected to the direct action of the drying gas. With this object in view the apparatus includes a plurality of passages for the material to be dried, a plurality of flues for drying gas extending through the passages and in open communication with each, and means for supplying the drying gas to the flues. Since in this arrangement the material comes into direct contact with the drying gas, heated air, which may be taken from the cooling chambers in which the char is cooled after the calcining operation, is preferred, although any other suitable hot gas might be used. The flues may be connected to a pipe for supplying the drying gas thereto, and auxiliary means may be connected to this pipe for supplying an additional quantity of drying gas to the flues. The apparatus may comprise a downwardly extending channel for the moist material, a plurality of lateral gas flues arranged to intersect the channel at distributed points so that the moist material in its downward travel successively drops into the lateral gas flues in contact with the gas therein, and means for supplying drying gas to each of the flues. In this construction the channel is preferably zigzag in form, and is intersected by the lateral gas flues, and both the channel and the flues are constructed of partition plates extending between adjacent division plates. In order to insure the thorough circulation of the drying gas through the char, the partition plates may be overlapped to form louvres. Furthermore, the apparatus may embody in its construction means whereby large heating surfaces are provided to enhance the efficiency thereof, not only as respects the amount of moisture removed from the material, but the output of the dryer as well. In providing the large heating surfaces of the drying apparatus, the apparatus includes division plates and

partition plates, there between forming downwardly extending channels for the material to be dried, each having therein a plurality of superimposed chambers. The division plates have apertures therein smaller in area than the cross sectional area of the chambers, and the corresponding aligning chambers in the various sections communicate with one another through these apertures, forming a series of continuous heating flues through the sections. By reason of these contracted apertures in the division plates, the end walls of the chambers act as baffle plates for the drying gas, and a large part of each of these walls is thus rendered available as a heating surface. Preferably the partition plates are angularly disposed relative to the division plates, and the superimposed chambers are provided with deflector plates describing a downwardly extending zigzag channel for the material to be dried, whereby the heating surfaces are still further increased. Moreover, the sections forming the channels for the material may be heated by a flue for hot gas external thereto, in which case the division plates may have additional apertures therein to permit the continuous flow of hot gas through the external flue. The invention comprehends as still another of its parts an apparatus for drying char having passage for the material to be dried and means for heating the passage by steam. The apparatus may be provided with a flue for hot gas separated from the passage by a heat-conducting partition. Whether or not this flue is embodied to supplement the heating of the passage for material by steam, the apparatus may comprise division plates and partition plates therebetween, forming a downwardly extending channel for the material to be dried, and means for heating the plates by steam. The channel may have therein deflector plates describing a zigzag passage for the material, and the deflector plates may be steam-jacketed to increase the heating effect of the steam on the descending column of material. Moreover, the steam jackets may be supplemented by steam pipes passing through the channel for material. The use of steam according to these arrangements is of considerable advantage, in that its quantity and temperature may easily be controlled, and, where used in conjunction with hot air or hot gas or both, the operation of the apparatus is greatly facilitated. The above described parts may be combined to produce, for example, an apparatus for drying char which is particularly adapted for use in conjunction with a char revivifying kiln, in which the channels for material, preferably zigzag in form, are arranged on either side of a central heating flue in which, preferably, the gas is led in at the upper part of the apparatus and back-and-forth downwardly between the two channels, and having a plurality of lateral flues located outwardly of the two channels, or intersecting them. Furthermore, the apparatus may have side walls and end plates provided with parts whereby access may be had to the several channels or flues for cleaning them, and the side walls provided with deflector plates extending inwardly therefrom. In the specific embodiment of the invention described hereinafter the apparatus comprises the combination of vertically disposed, spaced division plates, an inner set of diagonal partition plates supported on the division plates, an outer set of diagonal partition plates similarly supported and substantially parallel to certain of the inner partition plates, and walls and end plates, whereby there is formed two zigzag channels for the moist material with a central flue between them, and a plurality of lateral flues located outwardly with respect to the zigzag channels.

Furnaces for burning Molasses under Steam Boilers. *Hugh A. Griffin*, of Lindsay, Cal., U.S.A. *1,454,586*. (Three figures; six claims.)

Referring to the figures, it will be noted that a boiler *10* is arranged longitudinally above a hollow arch *11*; and that between the rear portion of the latter and the rear furnace wall *12* a passage way *13* is left for the products of combustion of the fire box *14* so that these products can enter the rear ends of the fire tubes *15*. The forward ends of the fire tubes *15* discharge into a header *16* from the lower portion of which an ash discharge pipe *17* leads. Ash arresting means are employed in the header above the level of the boiler, consisting of a fluid discharge pipe *18*, which discharges a sheet or film of water *19* across the header above the discharge ends of the fire tubes, the water serving to arrest the ash and also to wash the same steadily to any suitable point of discharge through the

ash discharge pipe *17*. Within the lower portion of the fire box *14* is a grate *20* preferably of the horizontal sliding type, disposed on grate supports *21* and actuated by a connecting rod *22* from an external shaking lever *23*. This grate may be in two sections, each with its shaking lever *23* and each with its connecting rod *22*, the latter of which may lead into the fire box through slotted openings *24* in the fire box doors *25*, the latter of which may have the usual or in fact any suitable draft arrangements. Into the side walls *26* of the furnace, opposite the upper portion of the fire box, and below the arch or crown wall *11* are set bearing-supporting plates and the like *27*, each having one or more bearing brackets *28* for hollow transverse shafts *29*, whose portions, between the bearing brackets *28*, are preferably squared (as seen particularly in Fig. 1) to receive thereon one or more cylinders *30* whose function is to support cylindrical drip catchers *31* disposed in endwise abutting relation and in any suitable number on the cylinders. Each of these cylindrical drip-catching plates has flanged ends *32*, and is circumferentially divided by lengthwise ribs and the like into a plurality of drip-catching receptacles, which in the rotation of the cylinders with the drip-catching plates thereon, receive molasses from transverse series of



drip apertures *34* of the arch or crown wall *11*, arranged therein along and above the axes of the cylinders. For the supply of molasses, a pipe *35* extends into the hollow of the crown wall or arch *11* and has diverging and downwardly inclined branch delivery pipes *36* whose lower curved ends enter the upper enlarged portions *37* of the drip apertures *34* so that from the single pipe *35* the drip or feed plates *31* of both cylinders may be supplied. The drip or feed plates *31* may be keyed or otherwise secured upon the supporting cylinders *30*, and the hollow shafts *29* are extended laterally beyond one side of the furnace to a sufficient distance adapting them to receive inter-engaging spur gears *38* and also adapting one of the shafts (as seen in Fig. 2) to receive a worm wheel *39*, engaged by the worm *40* of a shaft *41* mounted in brackets *42* at one side of the furnace, and driven from any suitable source of power as for instance through a belt *43* and pulley *44*. Thus it is obvious that in action the two supporting cylinders *30* will be rotated in opposite directions, and that due to this manner of feeding the molasses, the latter passes inwardly through the pipe *35*; and, dripping from the branches *36* of this pipe, will be broken up and carried around the cylinders by the drip or feed plates *31* in shallow pools, thus being gradually heated to a point of ready combustion upon the final discharge of these shallow pools on to the fire on the grate *20*. In this way the molasses is freed from most of its dilution water by the heat of the fire before it reaches the flame, and made suitable for instant combustion when the flame is reached and is thus in condition to generate greater heat in the furnace. The hollow shafts *29* on which the cylinders are mounted are continuously supplied with water as a cooling fluid.

GERMANY.

FILTER CLOTH FOR THE FILTRATION OF COLLOIDAL SOLUTIONS. *C. H. Fischer and J. Rahtjen.* German Patent, *374,093.* September 26th, 1918.

A cloth woven of fibre or of paper is covered with a metallic deposit by a spraying process, a material thus being obtained which is capable of giving a clear filtrate even in the case of mixture containing colloid particles.

ELECTRICAL DEPOSITION OF DUST PARTICLES FROM GASES. *Metallbank und Metallurgische Ges. A.-G.* (*A*) *373,772.* May 15th, 1920. (*B*) *373,785.* August 21st, 1921.

(*A*) An apparatus is described consisting of non-sparking electrodes for the deposition from gases of solid or liquid particles which are positively or negatively ionized. (*B*) The walls surrounding the electrodes are provided with plates of non-conducting material placed obliquely to the electrostatic field, making it possible for the walls to carry a charge opposite to that of the field.

POLARIMETERS (SACCHARIMETERS). *Optische Anstalt C. P. Goerz Akt.-Ges.*, of Berlin. (*A*) *342,845.* October 24th, 1921. (*B*) *358,994.* September 19th, 1921.

(*A*) Claim 1: Polarimeters, the half-shadow device of which is formed of one or several active plates set perpendicularly to the axis of the crystal, thereby characterized that the plates forming the half-shadow device shall so rotate the rays that, for the average concentration of the class of solutions examined (16-20 per cent. in the case of beetroot juices), the rotation dispersion of the non-homogeneous light polarized remains equal for both halves of the field of view. Claim 2: Polarimeters, according to Claim 1, thereby characterized that the plates forming the half-shadow device shall consist of dissimilar material so chosen in respect of its dispersion that with equal thicknesses of the plates compensation of the colour difference is effected for a certain average concentration of the solution under examination, that is, both halves of the field of vision have the same colour, the difficulty arising from a difference of colour in the two halves thus being eliminated. A costly compensator then becomes unnecessary in the construction of polarimeters for use with solutions of a certain low range of concentration.

(*B*) In the case of polarimeters in which the solution is observed in the form of a relatively long column, it is possible to use rock crystal (quartz or pebble crystal) for the polarizers and analysers in place of calc spar (which is becoming more and more difficult to obtain), provided that a cement permitting the utilization of the available double refraction to the fullest extent is employed. A suitable material is the product sold by the Griesheim-Elektron under the style of "Kleblack"; while a mixture of linseed oil and Canada balsam in suitable proportions, e.g., 4 : 1, can also be employed for the purpose. Claim: Polarization apparatus provided with tubes, thereby characterized that polarizer and analyser consist of rock crystal as the double-refracting material.

CLARIFICATION OF JUICE USING FERRIC SULPHATE (A MODIFICATION OF THE CARBONATATION PROCESS.[1]) *Emil Barnert.* *354,449.* June 11th, 1913 (published July 16th, 1923).

Diffusion juice, treated with a solution of ferric sulphate, is mixed with milk-of-lime at a temperature less than 50° C. in the usual amount employed in the carbonatation process (1·5 to 3·0 per cent. CaO of the roots), after which without further heating it is saturated with CO_2 and SO_2 and filtered, the second saturation and filtration after the addition of a small amount of milk-of-lime being carried out at the same temperature. Preferably using a Kestner apparatus, the clear juice thus obtained is concentrated to 60–64° Brix, saturated with CO_2, to a slight alkalinity to phenolphthalein (e.g., 0·05 CaO), and filtered.[2]

[1] Also Austrian Patent, 89,634.

[2] Compare this method of working with that described in German Patent, 364,424, taken out by the same inventor. See *I.S.J.*, 1923, 446.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922. Tons.
Total Receipts, January 1st to October 31st	2,611,273	..	3,288,206
Deliveries ,, ,, ...	2,610,696	..	3,286,576
Meltings by Refiners ,, ,, ...	2,518,080	..	3,233,313
Exports of Refined ,, ,, ...	195,000	..	719,000
Importers' Stocks, October 31st	577	..	1,630
Total Stocks, October 31st	88,232	..	56,648
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1920 21 Tons.		1921-22. Tons		1922-23. Tons.
Exports	2,036,417	..	3,430,488	..	3,114,777
Stocks	1,187,555	..	333,411	..	285,550
	3,223,972		3,763,899		3,400,327
Local Consumption	95,000	..	117,548	..	98,000
Receipts at Port to September 30th	3,318,972		3,881,447		3,498,327

Havana, September 30th, 1923 J. GUMA.—L MEJER.

Revised Forecast of the European Beet Sugar Crop.

(By our Continental Correspondent.)

	Metric Tons.
Germany	1,190,000
Czecho-Slovakia..	832,000
Austria	37,000
Hungary	110,000
Poland	400,000
Belgium	260,000
Netherlands	270,000
France	450,000
Italy	310,000
Spain	180,000
Switzerland	8,000
Denmark	110,000
Sweden	151,000
Bulgaria	30,000
Yugo-Slavia	50,000
Rumania	75,000
Great Britain	18,000
Total Europe, exclusive of Russia	4,481,000
Russia (Government estimates)	328,000
Total Europe, inclusive of Russia	4,809,000

United Kingdom Monthly Sugar Report.

Our last Report was dated the 11th October, 1923. The London Terminal Market retained its strength until the middle of October when October reached 27s. 9d., March 24s. 10½d., and May 25s. 1½d., after which it gradually fell until the end of the month and prices were generally 1s. 6d. per cwt. lower. During the first part of November, however, we have more than recovered this fall and the prices ruling at the time of writing are November 25s. 9d., December 25s. 6d., March 25s. 3d., May 25s. 6d., and August 25s.

Trade in actual sugars has fallen off considerably during the period under review. After the very heavy purchases during September and early October, and in view of the hesitating markets, buyers naturally bought with considerable caution on a strictly hand-to-mouth basis, thinking that the premium on nearby sugar was bound to run off. This view was certainly confirmed by the action of the London refiners who twice reduced their prices by 1s. per cwt. in one week, and to-day's quotations are No. 1 Cubes 58s. 9d., London Granulated 55s. 7½d. The recovery in the market, however, was the signal for the trade to re-enter for further purchases.

The refiners instituted a new departure by introducing a brand of Granulated sugar which is known as "T.L.," the price for which, while being the same as their London Granulated, will be free from any of the restrictions at present imposed on their other marks which fixes the price below which it is not allowed to be sold.

The U.K. Refiners only bought sparingly and their purchases have included Peru 96 per cent. from 25s. to 24s. c.i.f., Natal 96 per cent. 27s. 6d. c.i.f., Mauritius Crystals 28s. 9d. to 28s. 6d. c.i.f., and Continental Beet 88 per cent. 21s. f.o.b. Hamburg.

Foreign Refined has been offered more freely by the Continent for ready and prompt. The prices show a considerable decline in every case. Spot sugars have not been plentiful. Good Granulated sold from 56s. 6d. to 54s. 6d. duty paid, which fall corresponds with the British Refiners' reductions. Offers of American Granulated are still out of the question either for prompt or forward deliveries. Good business has been done in Czecho-Slovakian sugars for November/December from 25s. 3d. to 24s. 3d. to 25s. 3d., this is, of course, second-hand business, as the Czecho refiners continue to refrain from offering to the U.K. market because other countries in Europe are still paying more remunerative prices. Ready Czechos sold from 27s. 3d. to 25s. 3d. f.o.b. Hamburg. Business was done in ready Dutch sugars from 29s. 6d. to 27s. f.o.b. Holland, but their forward prices are still considerably above those ruling here for Czecho Granulated. Belgian Granulated and Crystals for November/December have been traded in at 24s. to 25s. to 24s. 6d. f.o.b. Belgium, and it is an interesting fact that this country has been constantly re-purchasing sugar already sold some time ago.

White Javas on the spot have been very scarce, but—in sympathy with other sugars—declined from 53s. 6d. to 51s. 9d. Very little business is reported in c.i.f. Javas, but the nominal quotation has fallen from 27s. to 25s. c.i.f. Some business was also done in White Javas for May/June shipment 1924 from 23s. to 23s. 9d. c.i.f. U.K.

The demand for Refined in America fell off very considerably, and in consequence the Refiners have adopted a more retiring attitude. Sellers of raws were pressing and Cubans declined from 6 cents to 5½ cents, at which price big business was done, and there was considerably more interest shown by buyers. Another reason for the decline in America was the anxiety on the part of the United States beet industry to market their sugar as soon as possible in order to obtain the current premium.

With regard to the European beet crop 1923-24 F. O. Licht has reduced his estimate as follows:—

Germany	1,250,000	Spain	190,000
Czecho-Slovakia	950,000	Sweden	151,000
France	500,000	Denmark	114,000
Poland	405,000	Hungary	110,000
Holland	300,000	Austria	40,000
Italy	325,000	Other countries	160,000
Belgium	300,000		
Russia	300,000	Total	5,095,000

This is a reduction of 250,000 tons on his previous estimate which we already forecasted in our last report. It is generally thought that this estimate will have to be still further reduced in view of the latest reports from Holland, Belgium, and the north of France, where the indications are that the crops will nowhere near reach the above figures. On the other hand, the Czecho crop is reported to be a very good one.

The exports from Java during October were 193,000 tons, and the total from the 1st April to the 31st October being 1,159,917 tons.

21, Mincing Lane,
London, E.C. 3,
9th November, 1923.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 300. DECEMBER, 1923. VOL. XXV.

Notes and Comments.

The Result of the Elections: A Political Stalemate.

Events have moved rapidly in the political world at home since our last issue went to press; the Conservative Party decided for good or ill to force an immediate election to obtain from the electorate a mandate for carrying out Mr. Baldwin's new policy of tariff reform which we outlined in our *Notes and Comments* last month. The immediate result of this decision was to galvanize into life the disunited Liberal Party, who made Free Trade their one plank and refrained from propounding any constructive policy of their own. Instead, they concentrated their attack on Mr. Baldwin's proposals; and with Mr. LLOYD GEORGE at their head conducting a whirlwind campaign throughout the land in favour of the old policy, it is not a matter of surprise that the Conservatives, with the short time at their disposal between the propounding of the new policy and the polling day, should have failed to convince the electorate that the change was in the best interests of the country. It is now admitted that it was an error of tactics to rush the election. Undoubtedly the large and attentive audiences everywhere listening to the Government's proposals were proof of an awakening interest; but the country, it seems clear, was unwilling to be hurried into a decision within the short period of four or five weeks. The arguments in favour of tariff reform were well received, but the old views were too firmly rooted in the mind of the average elector to be dispelled in a hurry and probably many men voted for a continuation of the old conditions, not through being enamoured of them but because they were determined to have more time to study the new proposals ere giving the latter their electoral support. Others, insufficiently informed, were adversely alarmed by election counter cries. The result of the election has been to reduce the Conservative party from 346 members to about 255, to increase the Labour party from 144 to nearly 200 and to increase likewise the Liberal representation from 117 to about 155.

Mr. Baldwin's policy as outlined in his address to the electors proposed to institute duties on manufactured goods coming into the country and thereby raise revenue by methods less unfair to our home production, which at present bears the whole burden of local and national taxation. In particular, it was his intention to apply the proceeds of these import duties to subsidizing agriculture to the extent of £1 per acre of arable land; and to reduce the duties on tea and sugar which at

present bear heavily on the household budgets. Save for certain preferences on fruit and tinned food already agreed to at the Imperial Conference in October, Mr. Baldwin's party resolutely set their faces against any taxation of food, and the wisdom of that was apparent during the course of the election, inasmuch as a "dear food" cry was raised notwithstanding, and must have influenced many of the voters. The main plank of the Labour Party was a Capital Levy and this was the only point which the Conservatives and Liberals were agreed in opposing. Otherwise each party followed its own programme, but as the Labour Party also opposed protection, it was obvious at the outset that the Conservatives to gain their aims would require a majority over both the other parties combined. This they have failed to do (as the above figures indicate) and though they still remain the largest party in the House of Commons, it is clear that they will be unable to carry on the Government of the country save by some form of coalition with another party, presumably with the Liberals. But coalition involves compromise, wherein each section tries to get a commanding share not only of the spoils of office but also of the programme of legislation. The result is seldom satisfactory; and when the country has had a sufficient experience of the latest phase of it another election will be inevitable.

The immediate result of the elections will be the shelving *sine die* of fresh tariff proposals. What will happen to the protective and preferential measures already in force will depend on who coalesces with whom. The Liberals as authors of the Safeguarding of Industries measure are not all keen on sweeping it away, although Mr. ASQUITH for one has expressed his intention of so doing. The sugar duties already exist and save that the amount of the duty is certain to be reduced next Budget, it is unlikely that it will be done away with if only on account of the considerable income accruing to the Exchequer from its imposition. Mr. LLOYD GEORGE himself is not unfriendly to the Colonies, so it is quite on the cards that Imperial Preference for sugar will continue. As for the home beet sugar industry, even the Labour party are not wanting in adherents to the idea of giving it encouragement.

In any event, single-party Government after only one short year of existence is doomed once more to suspension for some time to come, and the next few weeks will provide a very big game of "General Post" in the political world, the outcome of which cannot at the time of writing be hazarded with any degree of accuracy. But the Imperial ideal has assuredly had a setback, and for how long a term the next few months will give us some better inkling.

The Beet Sugar Industry at Home.

The British Sugar Beet Growers' Society wisely drew the attention of all candidates of Parliament in the recent elections to the existence of English sugar, by sending to each a small sample box of beet sugar produced from home-grown beet at the Kelham and Cantley factories. This is a granulated sugar of excellent quality and grain, and is of course "direct consumption" sugar, not having been through a bonechar refinery. Its circulation amongst our legislators of all parties should serve to carry conviction, where that is still needed, that a home sugar industry is a practicable and a desirable feature of our agricultural system.

Further news from the provinces shows that beet sugar propaganda is making headway in fresh quarters and provided the present fiscal preference is continued *sine die*, there seems no reason why the extension of beet sugar factories should not proceed apace. Amongst districts that have lately taken an interest in the subject, we may mention Ulster (where a Royal Commission appointed to inquire

into the development of the natural and industrial resources of that country has had its attention drawn to sugar beet growing), and Cornwall, where the soil and climate are claimed to be specially favourable for sugar beets.

Mr. BALDWIN in his election addresses had a special message of encouragement for this industry. "I am very hopeful" he remarked, "that, owing to the remission of the Excise duty, we may really be able to establish in this country a sugar industry. The Government are interested in one or two factories now working. There are 15,000 acres in England to-day under sugar beet, and there is no reason why there should not be half a million. Sugar beet this year has been produced equal to, and better than, the sugar beet in Holland. It is producing a remunerative crop. It leaves the land in good heart, and the wheat crops grown after it have proved themselves 10 to 15 per cent. better than the wheat crops grown on other land. There is no reason why these factories should not be a blessing in the rural areas throughout the country, leading to an enormously increased demand for labour of all kinds, and the Government having stabilized Dominion preference for a term of years will take into consideration the stabilization of the preference now given to domestic-grown sugar by the remission of the Excise duty, if we are returned to power. I am convinced that if it can only be seen that for a term of years the protection that exists for this infant industry will last, there will be no difficulty in finding the necessary capital to develop the industry."[1]

The Trend of Sugar Prices.

As might have been expected sugar prices have had an upward tendency in this country the last few weeks, the rise being from £5 to £6 per ton, while the retail prices have advanced ¼d. to ½d. per lb. This is due to the increasing scarcity of old crop Cubans and of new crop European beet. The latter, thanks to unfavourable weather, is not coming forward as quickly as was expected, nor is the crop of the magnitude that was originally anticipated; and stocks of sugar in the United Kingdom are said to be abnormally low. Hence till European beet is freely offered and the new Cuban crop sugars commence to arrive, there will be no improvement and prices may rise yet further for the time being. According to LAMBORN, the United Kingdom and the Continent have been quietly accumulating new crop cane sugars, and it is conservatively estimated that they have already purchased fully 150,000 tons of Cuba sugars for January to March shipments. The only danger in view is the possibility of political trouble in Cuba. From more than one source we learn that in this respect trouble is brewing in Cuba and unless it speedily blows over there is a risk that it may adversely influence the grinding season. No definite causes are advanced, but the present administration of Cuba is from one reason or another becoming increasingly unpopular and opposition to its continuing in office may conceivably take a pronounced line.

Sugar Cane Characteristics: The Engineer's Point of View.

From a contributor to our pages we have received the suggestion that when writers of papers on the sugar cane give particulars of specific canes, they should bear in mind that not only the agriculturist and the chemist are interested in the data but also the sugar machinery engineer. From the latter's point of view the following are desirable data: The Percentage of Fibre (hard or soft fibre); the Brix of Normal Juice: and the Purity of Normal Juice (and Glucose Ratio); and where at all possible these points should be stated, since they are of great value

[1] *Times* report of a speech at Reading.

to the engineer who has to arrange for the machinery to deal with the cane and its juice.

Our correspondent points out that most writers of text books on sugar-agriculture and sugar manufacture seldom say anything at all on these aspects. Instead, what we generally find to read is a good deal of information as to colour, joints, roots, eyes, germination, hairs, leaves, etc., all of considerable interest to the botanist, but not a single word as to the fibre percentage, or even as to the sugar percentage. In fact the data might refer to an ornamental flowering plant, instead of to one giving an edible product of world-wide importance. The agricultural side is of course of supreme importance, but only in connexion with the commercial returns of sugar; and to the man who has to arrange the machinery proportions for the production of sugar from a given cane, it is no use offering botanical facts relating to hair groups or leaf sheaths. The engineer is interested chiefly in the three points above mentioned, which are the points the sugar factory itself is chiefly concerned with.

There is a good deal to be said for our correspondent's complaint that these data relating to fibre and juice have not hitherto figured amongst the masses of information collated as to the characteristics of given canes. Doubtless the omission has been due in great part to the fact that it has usually been the botanist and the agriculturist who have undertaken the collating work, and they have failed to secure the collaboration of the chemist and the engineer of the factory. We are not concerned at the moment as to the cause of this failure; but the average planter (if not also the trained agriculturist) has some reason for thinking that if the chemists and engineers would confine themselves less to highly technical contributions and would meet the planters on a common level, the latter would be in a better position to tackle such matters as the milling characteristics of the canes they grow. At present it is extremely difficult to get reliable figures on the fibre content of canes unless the amount is extraordinary, and the botanist and agriculturist by themselves are largely helpless in the matter. But the economic importance of the milling operation is nowadays becoming more pronounced, and it would be a good thing if in the future those who collect and place on record the characteristics of given canes would secure from the appropriate sources the data covering the miller's point of view.

Continued Progress in India.

The interest shown in various directions in the great development which appears to be taking place in the sugar making districts of North India, through the introduction on a field scale of certain selected seedlings from Coimbatore, leads us to communicate an early note concerning progress reported in letters received. For the full details we must wait till the final crop results have been obtained, and these will presumably be written up by Mr. WYNNE SAYER who is in charge of the experiments, as was done with last year's crops, in the *Agricultural Journal of India.*[1]

The season has been as unfavourable, with regard to the monsoon rains, as last year was favourable. Only 23 inches have fallen, as compared with 60 last year, and this constitutes a low record as far as the memory of the planters extends. In spite of this, a magnificent crop of canes covers the ground, with hardly a blank and no sign of disease. The existence of 60 acres of canes as level as a wheat field, and so close that "a bed might be placed on top of it," is surely unique in the tract. The severity of the season has naturally affected the

[1] *I.S.J.*, 1923, pages 354-8.

three seedlings somewhat differently, and Co 210 has led this year all through. It is surmized that this may be partly due to the narrowness of the leaves in this seedling, less surface being exposed to transpiration, and the slightly thinner canes requiring, presumably, less soil water for their development. We are told, however, that it is somewhat doubtful whether this lead will be maintained, for a few good showers at the end of the rains have caused Co 13 to come up sharply and, anyway, this variety was very close behind at the time of writing. Although a very early maturing cane, Co 214 is not in such favour this year, because of its more recumbent habit and its greater fibre content. But certain new seedlings are now being grown on a field scale, and of these Co 232 appears likely to replace the last-named variety, as it is equally early in maturing and has not the special faults mentioned. The introduction of these canes has completely altered the aspect of affairs at the commencement of the milling season, in that they are ready to be milled a considerable time before the local canes are anything like ripe; and by an alteration in the time of planting it appears now to be probable that a good crop of canes can be matured at the other end of the season, so as to prolong the milling season at this time also. The possibilities are thus great, especially as the new canes produce something like double the amount of sugar obtained from the local ones.

The method of short-planting, introduced from Java, is now being widely followed by the planters, and it is probable that it will soon become a recognized part of the annual agricultural routine. It is stated that this method, applied to the rapid multiplication of newly-introduced varieties, saves as much as three years, and this is of some importance in the present case; some estates will thus be able within a very short time to have the whole of the fields under the selected Coimbatore seedlings. But there is another point in favour of this method, in that the planting time will by its means be no longer dominated by the harvesting season; and there are signs that it is inadvisable to plant all of the sets, as has hitherto been done, at the beginning of the hot dry season, when the young plants have just to sit still for at least three months before they begin to move. Changes in the time of planting would appear, from what has been said above, to be a useful means of prolonging the milling season still further.

But a matter of great importance to exotic planters who desire to try these thin, hardy canes is whether they can be successfully ratooned, a practice not general in India. And the uncertainty as to the ratooning power of the new seedlings is in a fair way to be removed. We hear that the ratoons are remarkably good and, in some cases indeed as good a crop is expected from them as from the plant canes. An even, regular field of ten foot ratoon canes was visible to all who inspected the fields in October, and such a stand is considered remarkable in view of the extremely adverse nature of the season.

British West Indian Trading Prospects.

A recent report of His Majesty's Trade Commissioner at Trinidad on West Indian trade prospects indicates that while the twelve months ending June last were in some respects the most trying of the exceedingly difficult and long drawn-out period of depression resulting so largely from the decline in sugar and cocoa prices in 1920, there are now in evidence signs of improvement. For this the recent rally in the value of sugar is in no small measure responsible. But a great deal of leeway has to be made up before there are abundant signs of prosperity in these British West Indian islands. The finances of their Governments, as we are told, have continued in the year under review to show a declining tendency.

Financial conditions in trading circles have also remained unsatisfactory—indeed in many instances they threatened to become much worse—and planters had great difficulty in securing advances from the banks in order to meet cultivation expenses, many of them being already heavily mortgaged. The measures taken by the Government to assist agriculturists did however materially assist the situation.

The 1923 sugar crop, thanks to a smaller acreage under cultivation and to the droughts that prevailed, was not up to the average. But as a result of the better price obtained, a larger acreage has been planted out for the 1923-24 crop. White sugar is now being produced in several factories. Exports of rum continued to decline and the manufacture of motor spirit instead of rum has now been undertaken on a commercial scale, and with efficient machinery, in British Guiana.

In view of these facts, it is patent to all unbiassed observers that the recovery of the British West Indies from this spell of depression is largely contingent on encouragement being continued to its staple product, sugar, in the home market. The decision registered at the Imperial Conference on the part of Mr. Baldwin's Government to continue the sugar preference for ten years at a fixed sum should go a considerable way to restore confidence. What is also wanted is a better knowledge at home in political and other circles of the exact conditions in the West Indies, and for this reason the projected tour this winter of a party of members of parliament under the ægis of the West India Committee should have considerable educative value. It is proposed that a party of 25 or 30 M.P.'s should leave England just before Christmas and visit Barbados, Trinidad, British Guiana and Jamaica. It is to be hoped that these will be drawn from more than one party, since it is obvious that interest in the colonies should not assume a partizan nature in the next House of Commons. But the most important thing of all is probably to interest capitalists and convince them of the possibilities for profitable investment in these islands.

The Trinidad College.

The Governing Body of the Imperial College of Tropical Agriculture, realising the need for the provision of scientists and technologists if the sugar industry of the British Empire is to be developed and our dependence on foreign countries for our sugar supplies obviated, are establishing and equipping at St. Augustine, Trinidad, a model sugar factory towards which the British sugar machinery manufacturers are contributing plant to the value of £20,000.

It is expected that the factory will be completed next year, and meanwhile the Governing Body have appointed Mr. E. C. FREELAND to be Professor of Sugar Technology, and Mr. P. E. TURNER to be his Assistant and Demonstrator. Mr. FREELAND was trained at the Louisiana Sugar Experiment Station and took the degree of B.S. at the Audubon Sugar School in 1918. Mr. TURNER was educated at University College, Reading, and took an honours degree (London) in Chemistry in 1922.

Other recent appointments to the College have been those of Mr. C. L. WITHYCOMBE and Mr. E. E. CHEESEMAN, who have been appointed Demonstrators in Zoology and Entomology, and Botany respectively. Mr. WITHYCOMBE obtained the degree of B.Sc. in Chemistry, Botany and Zoology at King's College, London, in 1921; M.Sc. in Zoology 1922, and Ph.D. in 1923; while Mr. CHEESEMAN graduated at the University of London, taking the First Class B.Sc. degree, with 2nd class honours in Botany, in 1921.

Fifty Years Ago.

From the "Sugar Cane," December, 1873.

W. EATHORNE GILL (whose name will be remembered as the chemist who first showed that the specific rotation of levulose is greatly diminished by the presence of basic lead acetate in the polarimetric assay of raw sugars) here called attention to the unsatisfactory nature of the clarification of juice in the factory, as carried out at that time, so that "the planter loses more sugar than he sells." He stated that "the misnamed purification, by adding lime to the juice, has been abundantly demonstrated as making matters worse"; and he claimed that he had solved the problem by using "appliances so as to evoke galvanism by the cane juice itself, sufficient to coagulate the albumen, albumenoids, gummy matters, etc., causing impurities to separate from the juice and float as scum." He further said that, as the result of this treatment, juice which was "clear, clean, bright, and of the colour of pale sherry," had been obtained by the manager of the Plantation Hague, West Coast, Demerara, who felt confident that "immense results" would be obtained from the process. No data regarding the cost of operating such a process was given.

Whether it is profitable or not to trash the cane was under discussion fifty years ago, and still remains a debatable point. In this number of our predecessor, a writer named THOMAS SCOTT pronounced such a procedure to be "both unnecessary and injurious," and exposed his views as follows: "All vegetation requires a free circulation of the atmosphere and exposure tc the rays of the sun. . . . . Denudation is rightly applicable to horticulture, but not to cereals, of which species the cane is one. Its leaves, while green, collect the oxygen from the air, and impart it to the watery fluids furnished by the roots, which convert them into saccharine matter. After performing their appointed office, like all vegetable substances they wither and die. . . . . Examine the juices in such joints where their leaves have either fallen off or are totally dead, and they will be found to be sweet afterwards . . . . . then try the juices in the upper joints, where their leaves are green, and they will be found to be of a sweetish, watery, bitter taste . . . . . Now the upper foliage of the canes effectively excludes the rays of the sun from their lower barrels, which have received their needed succour from the direct beams of that source of vegetable life, and . . . . . the lower and sheltered barrels need not these vital elements in their full and direct action, as were needed when in a green and rapidly-growing state. If these facts be admitted, I ask what tangible reason can be assigned to justify the expensive act of trashing?"

There were two articles of interest to the analytical chemist, the first being by H. LANDOLT on the determination of the insoluble matter of raw sugars and syrups, in which he returned amounts varying from 0·015 to 0·035 per cent. for cane sugars of 15 to 9 D.S.; and the second by E. RIFFARD on a method of determining sugar by means of iron. According to this last-named writer, the quantity of sugar capable of preventing the precipitation of iron from solution by ammonia is a constant, namely 25·87 grms. for each grm. of iron, which fact, he claimed, formed the basis of a process for the determination of sucrose, though it was disturbed by the presence of invert sugar.

The Case for the Carbonatation Process in the Manufacture of White Sugars.

With Particular Reference to South Africa.

By FRANCIS MAXWELL, D.Sc., M.I.Mech.E., F.C.S.

(*Continued from Page 578*).

THE COSTS OF MANUFACTURE.

The "cost of production" is the key to economic superiority in the comparison of various processes of manufacturing sugar. It is composed both of the costs involved in the manufacture proper and of the interest and depreciation in connexion with the installations required. We propose to discuss the first part now, and deal with the second under a separate heading later.

In view of the widely variant circumstances obtaining in the different cane sugar countries in regard to prices of material, wages, number of hands required for sundry operations, and the rest, it is manifest that figures of cost of manufacture pertaining to one country cannot be directly comparable with those pertaining to another. As a basis of comparison, however, figures of a particular country may be of some use. With this object in view, we shall turn our attention once more to Java, where the question of the manufacturing costs of sugar by the process of carbonatation in comparison with that of sulpho-defecation has been subjected to investigation as far back as 1898.[1]

Prior to the inception of De Haan's modification of the double carbonatation process, the opinion prevailed among sugar makers in Java that it was safe to assume that the manufacturing cost of the carbonatation sugar was about 5s. 6d. per ton (f. 0·20 — 0·25 per picul)[2] dearer than that of sulphitation sugar. This figure, however, does not take into account the greater yield of sugar obtained by the carbonatation process, which factor would reduce the above cost appreciably. That the process of carbonatation yields a higher recovery of sugar than that of sulpho-defecation is now an accepted fact, but the extent of the additional recovery is as yet a matter of controversy in Java.[3] Taking this factor of recovery into account, DE HAAN[4] calculated that to make one ton of sugar by carbonatation it costs only 6½d. (2 cts per picul) more than by sulphitation, while VAN DER WANT[5] finds a considerably higher figure, namely, 4s. 6d. (17 cts per picul). All the above figures, it must be remembered, refer to the old method of double carbonatation. This process, however, has since been almost generally superseded by the modification introduced by DE HAAN.

We may pause here to examine briefly the economic advantages claimed in favour of the new method over the old one. The superiority of the modification lies essentially in the great reduction in the consumption of limestone and coke. Whereas the old method of double carbonatation required in Java per 1000 tons of cane about 40–45 tons of limestone and 4·5 tons of coke, the application of De Haan's modification apparently reduces these quantities to about 23 tons of limestone and 2·5 tons of coke, so that a saving of about 45 per cent. is thereby effected at the limekiln station, which saving naturally applies, in a corresponding measure, to the wages involved in this operation. Proportionally to the decrease of lime used in the juice, a less amount of filter-cake is produced, which in turn means lower sucrose loss, fewer hands and less filter-cloth, and, finally, less wash

[1] *Java Congress Proceedings*, 1898, 152, 160.
[2] *Archief*, 1911, 4356; 1914, 1090; 1917, 539, 695. [3] *I.S.J.*, 1923, 576.
[4] *Archief*, 1911, 1358. [5] *Archief*, 1914, 1090.

water to be evaporated. Last, but not least, an appreciable increase in capacity is effected in the lime-kiln, the carbonatation station and the filter-presses in the case of existing installations.

The financial advantages of De Haan's method are thus apparent. This is not the place to discuss this process from a technical point of view, but the fact that the majority of carbonatation factories in Java have adopted this method[1] is sufficient to show that general opinion is in its favour.

By enhancing the value of the carbonatation process, the introduction of this new method has, as a matter of course, brought the question of superiority between carbonatation and sulphitation again to the fore.

After this necessary digression, we shall proceed to compare financially the modified process of carbonatation with the sulpho-defecation process. For Java, we may refer to De Haan's calculations[2] which are on a basis of 1000 tons of cane as follows:—

DETAILS OF ITEMS OF COST OF MANUFACTURE WHICH DIFFER IN THE TWO PROCESSES PER 1000 TONS OF CANE.

Carbonatation (De Haan).

	£	s.	d.
Limestone, 25·78 tons at 7s. 4d. per ton	9	9	0
Coke, 2·22 tons at £3 2s. 5d. per ton	6	18	7
Sulphur, 460 lbs. at 1d. per lb.	1	18	4
Filter-cloths for second carbonatation and thin juice filtration	0	13	5
Filter-cloths for first carbonatation	0	14	0
Total expenditure in materials	£19	13	4
Wages for work differing from that in sulphitation	3	7	5
Removal of filter-cake	1	4	3
Total costs	£24	5	0

Sulphitation.

	£	s.	d.
Lime, 0·86 ton at £2 12s. 2½d. per ton	2	4	10
Sulphur, 800 lbs. at 1d. per lb.	3	6	8
Filter-cloths	0	1	5
	£5	12	11
Wages for work differing from that in carbonatation	1	13	1
Removal of filter-cake	0	5	5
	£7	11	5

Taking the extra yield of sugar obtained by carbonatation at 2·16 per cent. of the available sugar according to Winter's formula × 0·94, DE HAAN works out the corresponding value of the sugar, after deducting cost of packing and transport, at £20 14s. per 1000 tons of cane (f. 15·52 per 1000 piculs).

Introducing this figure in the comparision between the new method of carbonatation and the sulphitation processes, we get:

	Carbonatation (De Haan). £	s.	d.		*Sulphitation.* £	s.	d.
Costs of manufacture differing in the two processes, per 1000 tons of cane	24	5	0	..	7	11	5
Deduction for value of extra sugar recovered	20	14	0	..	—		
	£3	11	0		£7	11	5

[1] *Archief Verslagen*, 1922, 122.

[2] *Archief*, 1917, 542; and 1911, 1355; transcribed into English weights and currency.

Thus, by taking into account the value of the extra amount of sugar recovered by carbonatation, the above calculations[1] show that the costs of manufacture by carbonatation (De Haan's modification) per 1000 tons of cane are actually £4 0s. 5d. less than by sulphitation.

At a ratio of 10 tons of cane to 1 ton of sugar this means 9½d. per ton of sugar in favour of carbonatation. In considering these figures, however, it is important to keep in view the fact that they are based on pre-war prices obtaining in Java, so that they do not lend themselves to general comparison, though they may serve for mutual comparison of the two methods of clarification.

Let us now discuss the question with reference to Natal. On glancing over the various items of expenditure in regard to the carbonatation process, it will be noticed that those for limestone and coke are by far the greatest. Indeed, they are such as to play a significant part in deciding the choice between the two processes. In view of the weight of crude limestone and the great amount of this material required for carbonatation, the question of transport is obviously a vital one. Where factories are situated comparatively near to sources of limestone, for instance, as in Java and in Mauritius (in which latter island, the coral reefs afford a convenient and abundant supply), this factor may almost be disregarded; but, in cases such as, for example, certain mills in Zululand, where the bulky material has to be carried very long distances, the cost of transporting limestone becomes prohibitive.

Owing to the high price of limestone obtaining in Natal, namely, 25s. per ton delivered at mills in the vicinity of Durban, the carbonatation process is economically handicapped at the very outset of a comparison. For a financial comparison of the two processes in Natal, there are as yet no complete figures, such as those for Java, available for publication; consequently, we are reduced to allowing a certain element of speculation to enter into our calculations.

Assuming a ratio of 10 tons of cane to 1 ton of sugar, and the consumption of 0·3 ton of lime and 0·03 ton of coke per ton of sugar; and, further, basing the calculations on present prices in Natal, we find the following comparison as to chemicals used per ton of sugar:—

Sulphitation.	s.	d.
Lime, 73 lbs. at £3 per ton	2	2
Sulphur, 18 lbs. at £8 8s. 4d. per ton	1	6
Phosphoric acid, 5·4 lbs. at £25 per ton	1	4
Hydro-sulphite ("Blanchol")	3	0
	8	0

Carbonatation.	s.	d.
Limestone, 0·3 ton at 25s. per ton	7	6
Coke, 0·03 ton at £2 6s. 1d. per ton	1	4
Sulphur, 10 lbs. at £8 8s. 4d. per ton	0	10
	9	8

In regard to wages and sundry other expenses, there are unfortunately no accurate figures at our disposal, but it is considered safe, when taking the local conditions into account, to put the difference against carbonatation at about 2s. per ton of sugar (this includes a margin of error in favour of sulphitation).

[1] The tabulation in which these calculations are summarized is by the present writer, as it appears that some confusion has occurred in the setting out of De Haan's figures on page 543 of the *Archief*, 1917, which, to the best of the present writer's knowledge, has not been rectified elsewhere.

According to the above figures, it costs about 3s. 8d. more to manufacture 1 ton of sugar by carbonatation than by sulphitation. But so far in these estimates no account has been taken of the extra yield of sugar from carbonatation. This figure, as shown by actual results of the factory under consideration, is somewhere about 0·7 per cent. on cane. But even taking this figure at, say, 0·5 per cent. and taking an unfavourable price for this sugar, say, an average of £18 per ton, after deduction of cost for packing and transport (the price at Durban at present is about £29 per ton of sugar), it works out that this extra yield represents 18s. per ton of sugar. But over and above this, we find that carbonatation sugar commands at present in the Durban market about 25s. per ton more than the average sulphitation sugar. It will therefore be seen that after making due allowance for the extra fuel bill and sundry other factors, and even increasing the margin of safety, a substantial advantage remains to the credit of the carbonatation process.

As the figures speak for themselves, we may conclude with the following summary:—

By reason of the peculiar conditions obtaining in Natal, both in regard to the nature of the cane and especially to that of the sugar market, the carbonatation process is superior to the sulpho-defecation process from the financial point of view.[1]

THE QUALITY OF THE SUGAR.

The quality of sugars is generally judged by the colour, lustre, size and uniformity of the crystals, and, last but not least, the durability in regard to storage. All these properties are, to a greater or less degree, dependent essentially upon the manner in which the clarification of the juices is carried out. As already said elsewhere, it is not proposed to enter into technical considerations, hence let it suffice to state that the more energetically and thoroughly the purification process is conducted, the more readily the above enumerated qualities of the resulting sugar are achieved. This is particularly the case with Natal and Zululand, owing to the peculiarly refractory nature of the Uba juices, as has been discussed in a preceding chapter.[2]

In Natal, where carbonatation sugar is made at Mount Edgecombe, there is a striking difference in the quality of the sugar, compared with the average produced in sulphitation factories. Only one or two of the latter can approach a comparison; in particular, one mill which has acquired a reputation for the quality of its sugar, but it must be added that it is a small factory turning out only about 3000-4000 tons of sugar per season, which enables it to take ample time in clarifying and especially settling the juices, syrups and molasses.

The fact that carbonatation sugar commands a price of about 25s. per ton higher than the average sulphitation sugar (which figure naturally varies according to the market and goes as high as £2), shows clearly its superiority.

From the above and from what has been already said in the introduction, the following summary may be drawn:—

Sugar produced by the carbonatation process is, as a rule, superior to that made by the sulpho-defecation process. In South Africa, where not only the quality of the sugar but also its uniformity are the main desiderata, carbonatation is the superior process.

[1] This statement will be endorsed in a subsequent article which will deal with the costs of installation, the fuel question, etc. [2] *I.S.J.*, 1923, 572.

The Hele-Shaw "Stream-Line" Filter.

Introduction.

In papers recently presented to the Royal Society of London,[1] and the Society of Chemical Industry,[2] Dr. H. S. Hele-Shaw, F.R.S.,[3] describes an apparatus which not only revises all pre-conceived ideas as to filtration, but also renders possible on a commercial scale processes of ultra-filtration which hitherto have been impossible even in the laboratory. An extraordinary sensitiveness is the outstanding feature of the filter. For example, a solution of raw sugar, on being passed through it, is transformed into a perfectly colourless liquid, from which the colouring matter, gums, and pectins have been completely separated.

Principle and Construction.

Dr. Hele-Shaw explained in these papers that in the course of certain experiments with thin films he had found that, not only is it possible to separate the very finest matter in suspension from a liquid, but, if the film were sufficiently attenuated, two fluids of different densities could be separated one from the other. These films are provided by passing the liquid through layers of material, namely a pack of sheets of impermeable paper, having a suitable matted or rough surface. This principle of edge filtration is made clear by reference to the figures shown herewith. Fig. 1 shows a section of three small discs or sheets of the impermeable paper, and also the plan of one of them, the liquid passing under pressure from the channel *A* between the layers in the form of a thin film into the smaller outlet channel *b*. Fig. 2 shows on the left the stream-line nature of the flow from the large inlet channels to the smaller outlet channels between any two layers of the paper.

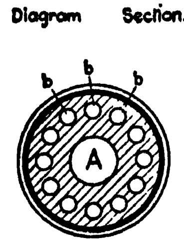


Fig 1.

In construction, therefore, the Hele-Shaw filter consists of a pack of say 4000-5000 perforated sheets or discs of special impermeable paper, on the surface of which there is a slight "tooth" or matt surface, the effect of which is to leave minute passages for the liquid, the size of these passages being restricted as desired by the imposition of end-pressure upon the pack of sheets. The liquid under treatment is pumped into a large channel *A* (of which there may be many), on the walls of which the residuum gradually collects, thence percolating in a so-called "stream-line" between the layers into the small channels *b*, from which the filtrate is drawn.

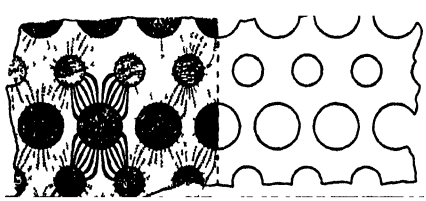


Fig 2.

By degrees a film is formed on the inner surface of the large channels *A*, consisting of particles which are not able to pass between the layers of paper. In

[1] *Proceedings of the Royal Society*, 1923, Series A, Vol. 103, No A 723, 556-561.

[2] *Journal of the Society of Chemical Industry*, 1923, 42, No. 35, 353-356 T.

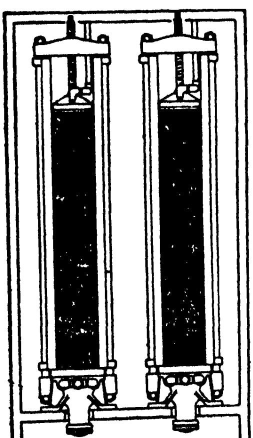
[3] Dr Hele-Shaw is a distinguished engineer, who has held professorial appointments at the University College, Liverpool, the Liverpool School of Technology, and the Transvaal Technical Institute. He has published numerous papers on mathematical, physical and engineering subjects, and his name is well-known as the inventor of certain clutches, pumps and other apparatus.

each of these large channels *A* is a light, free-fitting, floating piston, which normally lies in a pocket in the end covers. When, owing to the slackening of the rate of flow, it is necessary to remove this residuum, the liquid to be filtered is admitted under pressure behind the piston, driving before it the deposit, this being evacuated through ports in the end cover. This simple method provides a practically continuous-acting filter, the cleaning cycle taking only a few seconds; and it has the advantage of dealing expeditiously with filtration where the effluent is the valuable product. According to the purpose for which they are to be required, "Stream-Line" filters are supplied, either in the vertical form shown in Fig. 3 with evacuation of the residuum by displacement (as just described), or simply by flushing; or they may be of the horizontal form.

Discussion on the New Filter.

Following the reading of the paper presented to the Society of Chemical Industry, a discussion took place, some of the more interesting points being as follows:

Prof. J. W. Hinchley said that Dr. Hele-Shaw had produced a filter which could be worked up to any rate and do any class of filtering work, provided that a firm cake was not produced; but it must not be imagined that this apparatus would displace all other filters. It would not displace any completely, but by its aid the work could be done very much better. It would enable operations to be carried out that could not be performed before. One of the greatest problems to-day is the separation of colloid materials. The only difficulty which he foresaw was to enable people to use the filter at the proper rate of filtration, because with these stacks of paper the rate of filtration might be only one-fiftieth for one material what it was for another. Alkalis attack the paper used for the present apparatus, and very little more than 1 per cent. would be sufficient to stop the filtration.



Twin vertical type (700 gallons per hour).

Fig. 3.

Mr. F. H. Carr remarked that if, as Dr. Hele-Shaw seemed to suggest, the new filter could make it possible to separate large molecules from small ones, it would be of the utmost value for scientific and technical purposes alike. Further, the apparatus might be used for the grading of bacteria of different sizes.

Dr. Hele-Shaw replying to the above two speakers, and to a number of others taking part in the discussion, stated that the question of the end pressure to which the pack had to be subjected to effect efficient filtration is very important, such pressure varying according to the material to be filtered. He did not know if the effect was one of adsorption or of filtration, and it is for the chemist to go into that and other interesting questions. The removal of colour from solutions had been successful in every case; all that is necessary is to find the right pressure to use. The wear and tear on the paper is practically nil, and the secret is the roughness of the surface, which gives the requisite stream-line flow.

Some Results obtainable with the Apparatus.

A few of the remarkable effects which may be obtained with Dr. Hele-Shaw's apparatus may be briefly summarized: Aniline and other dyes (which pass completely through all other filters) are intercepted by it, giving a colourless and

clear filtrate. Even erythosin, the powerful dye, which has a brilliant orange colour with a florescent green glint when diluted with 5 million parts of water, is completely separated, leaving a colourless filtrate. Peat water loses its colour. Lubricating oil rendered cloudy by a small amount of water in emulsion is turned clear by filtration through this apparatus, the water and oil separating out from the filtrate almost immediately after passing through. Milk gives a clear filtrate, nearly tasteless.

In regard to a solution of raw sugar, a liquid which is perfectly free from colour, pectins and gums has resulted. Evidence is stated to have been obtained in these experiments that the sugar molecule had been intercepted to a large extent. So far, however, it had not been possible so to adjust the pressure on the pack that only the colouring matter, gums, pectins, and like colloidal matter was separated. If this could be done, and if it could be proved that the working capacity of the "Stream-Line" filter on the technical scale for the filtration of raw juice was reasonably high, this apparatus might become one of extreme interest in the cane sugar industry. Its application would render clarification (as now carried on) unnecessary; and would enable any plantation to produce a syrup from which the finest white sugar could be boiled with the formation of very little molasses, or salt-containing mother-liquor.

The Pectic Substance of Sugar Cane Fibre.[1]

By R. G. W. FARNELL, A.R.C.S.,

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In a previous report to the Sugar Research Association on the pectic substance of plants,[2] it was indicated that further investigations were necessary to compare the pectinogen in cane fibre with the soluble pectin of the juice, and also to study the precipitation of pectin during the various methods of clarification in practice. An account is now given of some work done partly on these lines at the Imperial College of Tropical Agriculture from March to July of this year, which it is hoped to continue.

PECTIC COMPOUNDS.

At present three definite substances belonging to the pectic group can be distinguished: (*1*) *Pectinogen* (also termed pectose and protopectin), the parent substance, which is widely distributed in nature, and forms the binding constituent of vegetable tissues. It is practically insoluble in cold neutral solutions, and is converted into pectin by the action of enzymes and acids. (*2*) *Pectin* (formerly spelt "pecten"), a soluble substance present in most fruit juices, having the property of forming gels with concentrated sucrose solutions in the presence of weak acids. (*3*) *Pectic acid*, which is not known to occur in nature, and is derived from pectinogen and pectin by the action of alkalis. Its salts (excepting that of ammonium) are insoluble, and the formation of calcium pectate provides a method for the determination of pectin.

EXTRACTION OF PECTINOGEN FROM CANE FIBRE.

Preparation of raw material.—Owing to lack of necessary apparatus when the research was begun, it was not possible to use cane as the raw material; but instead various samples of bagasse were collected from two factories in Trinidad.

[1] Report made to the British Empire Sugar Research Association, dated July 20th, 1923. Here published (in abridged form) by kind permission of the Association.

[2] *I.S.J.*, 1923, 248-251.

The Pectic Substance of Sugar Cane Fibre.

Very much the same method was used for its preparation as was applied in the case of turnips in the previous research.[1] After being chopped up roughly, the bagasse was washed in cold running water for three days or longer, drained, squeezed out in a cloth by hand, and washed again till α-napthol showed no traces of sugar in the water expressed, the fibre being finally air-dried to a moisture content of 10-15 per cent.

Extraction of the pectinogen.—Cane fibre thus prepared was digested with either ammonium oxalate or oxalic solution (0·5 per cent. strength in both cases) for about two hours at 80-90°C.; the extract clarified by filtration through filter pulp; and the pectin precipitated by the addition to the liquid of twice its volume of alcohol (90 per cent.), the gelatinous precipitate being washed with graded concentrations of alcohol, and with ether, and finally dried *in vacuo* over phosphorus pentoxide.

As was pointed out in the previous report,[2] the pentosan content of the pectin varies according to the nature of the extracting agent, being higher in the case of ammonium oxalate than in that of pectic acid, the reason appearing to be due to the alkaline nature of the former solution, so that some methyl alcohol becomes split off (pectin reacting as a methyl ester[3]), while traces of xylan might also be extracted. Fine cane fibre (passing a 1·5 mm. sieve) extracted with an 0·5 per cent. solution of ammonium oxalate (pH, 8·4) gave 0·23 per cent. of pectin, per cent. fibre, and 29·18 pentosan, per cent. pectin; while with an 0·5 per cent. oxalic acid solution (pH, 2·0) the respective values were 0·56 and 22·1 per cent.

Determination of Pectinogen in Cane Fibre.

Preliminary experiments.—Precipitation of pectin from an aqueous solution by alcohol is far from complete when the pectin is present in dilute solution; but the precipitation of calcium pectate forms the basis of a quantitative method. In order to apply this method, it is necessary to convert the pectinogen into pectin by some agent other than ammonium oxalate or oxalic acid. Miss Carré and Miss Haynes[4] have recently devised a convenient procedure, which in brief consists in converting the insoluble pectinogen into soluble pectin by hydrolysing the plant tissues with N/20 hydrochloric acid, and applying the calcium acetate method to the neutralized extract.

Before adapting the Carré-Haynes method to the examination of cane fibre, experiments were made to determine whether the pectin extracted by 0·5 per cent. oxalic acid was identical with that obtained by N/20 HCl. On extracting washed and sun-dried bagasse (of coarse texture) with these two liquids, the pentosan per cent. pectin was found to be 19·7 and 21·5 respectively, which result indicates the similarity of the two pectins. Other experiments were carried out for establishing other conditions, and the following conclusions arrived at: (1) That it is necessary to reduce the cane or bagasse fibre to such a degree of division that it passes through a 1·5 mesh sieve; and (2) that the duration of the acid hydrolysis should be about two hours, heating being carried out in a boiling water-bath. Here follow details of the Carré-Haynes method of determining pectinogen as applied to cane fibre.

Details of Carré-Haynes method.—Three grms. of air-dried fibre (passing a 1·5 mm. mesh sieve) are placed with 100 c.c. of N/20 HCl in a flask and left overnight. In the morning, the flask is connected to a reflux condenser, and heated in a boiling water-bath for 1½ to 2 hours. After cooling, the extract is filtered through

[1] *Ibid.*, page 249. [2] *Ibid.*, page 250. [3] Th. von Fellenberg, *Biochem. Zeitsch.*, 1918, 85, 45.
[4] *Biochem. J.*, 1922, 16, 60, 704-712.

some fine doubled muslin on a small Buchner funnel, and the residual fibre well pressed to thoroughly extract the acid solution of pectin, about 85 c.c. of the original 100 c.c. being usually recovered. After passing the pectin solution through filter-paper, two portions of 40 c.c. each are neutralized with 20 c.c. of N/10 caustic soda; about 200 c.c. of water and a further 50 c.c, of N/10 caustic soda are added, after which the two liquids are allowed to stand for at least one hour to complete the formation of sodium pectate. Calcium pectate is now precipitated by adding 25 c.c. of N/1 acetic acid, and after 5 mins. 25 c.c. of *M.* calcium chloride solution, the liquid being well stirred, left for half-an-hour, and gently boiled for 5 mins. The gel formed is filtered off, and washed on a small 11 cm. hardened pleated paper, washing being continued until the filtrate is chlorine-free, which usually requires about 500 c.c. of water. The precipitate is washed back into the original beaker, boiled with water for 5 mins., filtered through a tared Gooch crucible or Soxhlet tube, and dried to constant weight, which requires about four hours. This precipitate of calcium pectate contains 7·6–7·8 per cent. of calcium, but it has been found more convenient not to correct for this amount, as the supposed displacement of two methoxyl groups by one calcium atom causes an insignificant increase in the molecular weigh of a substance of such molecular complexity as pectin. It is advisable to run the determinations in duplicate, thus obtaining the mean of four weighings of calcium pectate. In calculating the result, the volume of the extract from the Buchner funnel is assumed to be 100 c.c. (instead of about 85 c.c.), the composition of the liquid remaining in the fibre being taken to be the same as that of extract.

Results obtained.—On applying this method to samples of cane fibre from different sources, the following results were obtained:—

		Pectinogen (as calcium pectate), per cent. fibre (oven-dry basis).
Bagasse from	Naudet digesters	1·00
,, ,,	11-roller mill	1·22
,, ,,	8-roller mill	1·06
Bagacillo ,,	juice strainer	1·09
,, ,,	syrup ,,	0·55

These results therefore show the amount of pectinogen contained in cane fibre to be small compared to that found for turnip, onion, pea and pod, previously reported,[1] viz., 20 and 16 and 8 per cent. respectively. The figures for the *bagacillo* from the juice and syrup strainers (of a Demerara factory) are suggestive, and perhaps indicate a partial conversion of the pectinogen into pectin during the different stages of manufacture.

No previous data has been found concerning the amount of substance in cane fibre which would correspond to pectinogen. BROWNE[2] states that pectin ("gums") is present up to 0·2 per cent. of the cane, but he refers to the alcohol precipitate obtained from cane juice (after deducting the ash and the protein equivalent to the nitrogen present). It is now known that alcohol precipitates in part the soluble pectins (principally xylan) contained in the juice, so that one cannot regard the precipitate as representing true pectin.

EXTRACTION OF CANE FIBRE WITH ALKALINE SOLUTIONS.

Samples of washed cane fibre (passing through a 2·5 mm. mesh sieve) were extracted with different concentration of: (1) Lime water; (2) ammonium hydroxide; and (3) caustic soda, at room temperature and also at 98°C., pectinogen determinations being carried on aliquot portions of the filtered extract, and alcohol precipitates also obtained in some cases.

[1] *I.S.J.*, 1923, 250. [2] *La. Bulletin*, No. 91.

In the case of lime water (of concentrations from 0·02 to 0·04 N/1), no pectinogen was dissolved in any of the tests made, which is contrary to the theory of PRINSEN GEERLIGS[1] that the pectin in cane juice owes its origin to the action of lime on particles of cane fibre. Methyl alcohol was found to be present in the extracts, the significance of which is discussed later. In the case of ammonium hydroxide (sp. gr., 0·96) only 0·27 per cent. of calcium pectate was found in the extract, while with N/20 HCl the amount was 1 per cent. In the case of caustic soda (N/1 and N/4 concentrations), no trace of pectinogen could be found in the extracts.

Pentosan and methyl pentosan determinations were made by the Tollens-Kröber and Tollens-Ellett methods respectively, and the following results were found :—

	Pentosan, per cent. Fibre.	Methyl Pentosan, per cent. Fibre.
Bagasse from 11-roller mill	25·0	none
,, ,, ,, ,,	26·0	none
,, ,, Naudet digester	31·4	0·6
,, ,, 8-roller miller	27·2	none

These results agree with those recorded by BROWNE[2] and PRINSEN GEERLIGS.[3] The former found 25 per cent., while the latter, examining Black Java and various seedlings at different stages of growth, found an increase of the pentosan content. Increase of pentosan with the age of plants is general.

It appears that only a small proportion of the total pentosans present in cane fibre are extracted by dilute caustic soda. It has been shown by LENZE, PLEUS, and MÜLLER[4] that to remove from wood the substances yielding furfural (on distillation with 12 per cent. HCl) repeated extractions with 17 per cent. caustic soda are necessary, and even then the residues give traces of furfural. The same authors have demonstrated that in the case of wood there is no real correspondence between the amount of wood gum (xylan) and the total furfural-yielding constituent present, which they claim to be a "xylo-hemicellulose." Whether the same is true of cane has not been determined.

PRELIMINARY STUDY OF THE HEMICELLULOSE OF CANE FIBRE.

To obtain some idea of the distribution of hemicellulose in the cane, galactan and mannan (the two constituents of hemicellulose described by CROSS and BEVAN)[5] were determined using sample of cane fibre. Galactan was determined by the method of MIYAKE described by DORE[6] and mannan by that due to SCHORGER,[7] the following being the results obtained :—

Sample.	Galactan, Per cent. Fibre.	Mannan, Per cent Fibre.
Bagasse from Naudet digesters	0·10	None
,, ,, 8-roller mill	0·20	,,

Thus mannan was found to be absent, while the small amount of galactan could be accounted for as a constituent of the pectinogen in which it may be present up to 50 per cent. From these preliminary experiments it appears that the hemicellulose if present in cane fibre is not of the mannan-galactan type described by CROSS and BEVAN.[8] Further investigation is necessary to decide whether it is of the xylo type of LENZE, PLEUS, and MÜLLER.[9]

[1] *Archief*, 1893 ; through *J. Chem. Soc.*, 1894, A (2), 112. [2] *La Bulletin*, No 91. [3] "Cane Sugar and its Manufacture," page 44. [4] *J. pract. Chem.*, 1921, 101, 213. [5] "Lectures on Cellulose," 1912, 37. [6] *J. Ind. Eng. Chem.*, 1920, 12, 477. [7] *Ibid.*, 1917, 9, 748. [8] *Loc. cit.* [9] *Loc. cit.*

EXTRACTION OF CANE FIBRE BY VARIOUS SOLUTIONS.

Samples of cane fibre (from an identical source) were extracted with: N/20 HCl; weak acetic acid (of pH 5·0, i.e., approximately the same value as cane juice); distilled water; and weak lime water (pH 8·8, i.e., about the same value as over-limed cane juice).

10 grms. of the fibre (passing through a 2·5 mm. mesh sieve) were placed with 500 c.c. of the hot extracting solution in a beaker, which was introduced into an autoclave, the temperature of which was quickly raised to 120°C. (248°F.), at which it was maintained for about 10 min. After allowing pressure of the autoclave to fall to atmospheric, the extract was filtered through muslin on a Buchner funnel, the fibre separated being pressed first by hand and then in a tincture press, the combined extracts filtered through paper, and made up to 500 c.c. with washings from the pressed fibre. Using aliquot portions of this liquid, the following determinations were made :—(1) Pectin, as calcium pectate by the Carré–Haynes method; (2) total dry matter, by evaporation on the water-bath, and drying the residue at 100° C. and (3) pentosan by the Tollens-Kröber method. The results, including some previous extraction of cane fibre by distilled water and acetic acid (pH 5·0) at 98° C. are given below :—

Extracting solution	Time (mins.)	Temperature degrees C.	Dry matter extracted, per cent. fibre.	Pentosan extracted per cent. fibre.	Pentosan per cent. dry matter.	Calcium pectate extracted per cent. fibre.
1. *N/20 HCl.. ..	90	98	12·4	2·31	18·7	0·82
2. Acetic acid (pH 5 0)	30	98	1·2	not determined	—	0·13
3. Acetic acid (pH 5·0) ..	11	120	3·5	0·74	21·3	0·14
4. Distilled water.	30	90	1·66	not determined	—	0·11
5. Ditto	12	120	2·78	0·50	17·9	0·19
6. Lime water (pH 8·8) ..	12	120	2·37	0·44	18·4	none
7. N/20 HCl	120	90	13·5	not determined	—	0·72
8. Ditto..	12	120	22·9	4·20	18·5	0·16

A study of the above results leads to the following conclusions: (1) With the same extracting agent, the effect of extracting at temperatures over 100° C. is to increase the total matter extracted. (Compare experiments, 2 and 3, 4 and 5, 7 and 8). (2) The dry matter extracted contains approximately the same amount of pentosan irrespective of the nature of the extraction. This substance may possibly be of the same nature as the xylo hemicellulose of LENZE, PLEUS, and MÜLLER. In addition to the pentosan, the extract contained a certain amount of ash dissolved from the fibre, usually from 10 per cent. to 15 per cent. of the dry matter. The dry matter was hydroscopic and reduced Fehling's solution. (3) With weak acetic acid (pH 5) and water, the amount of pectinogen extracted at 120° C. is slightly greater than that extracted at 98°C. (Compare experiments 2 and 3, and 4 and 5). (4) With strongly ionized acid as N/20 hydrochloric acid, the effect of extracting cane fibre at 120° C. is to diminish the amount of pectinogen dissolved. Possibly the pectin is partially hydrolysed at this temperature and hydrogen-ion concentration into arabinose and galactose, and is not precipitated as calcium pectate. (5) Calcium hydroxide even in as low concentration as 0·006 per cent. CaO (pH 8·8) fails to extract any pectinogen at 120° C. (experiment 6) whereas distilled water at the same temperature (experiment 5) extracts 0·19 per cent. pectinogen, the total amount present being 0·72 per cent. of the fibre (experiment 7).

* Experiment 1 refers to a different sample of fibre than that used in the other experiments. It was included, as it was the only one available for pentosan figures relating to the fibre extracted by N/20 hydrochloric acid at 98° C.

PRECIPITATION OF PECTIN BY CALCIUM HYDROXIDE.

The fact that dilute lime water had failed to extract any pectinogen either at 98° C. or at 120 C. led to some experiments being made to determine the precipitation under the conditions of the standard method of estimation due to CARRÉ and HAYNES.

Some fibre was extracted by N/20 hydrochloric acid at 98° C., the extract filtered, and an aliquot portion treated in the usual way, first neutralizing, then adding N/10 caustic soda, N/1 acetic acid and finally *M.* calcium chloride solution. To other portions of the extract were added varying quantities of lime water of known strength, and after two hours definite volumes of N/1 acetic acid. Precipitates were obtained in the cold, but except for one case (experiment E) the solutions were brought to the boil. The results of the experiments are given in the following table:—

Method of precipitation.	Concentration of CaO per cent. solution.	Calcium pectate precipitated from 50 c.c. of extract. grm.	pH of solution from which precipitation occurred.
A.— 50 c.c. N/10 NaOH 25 c.c. N/1 CH_3COOH 25 c.c. M. $CaCl_2$	($CaCl_2$ = 0·35% CaO)	0·0250	4·4
B.— 50 c.c. 0·04N $Ca(OH)_2$ 25 c.c. N/1 CH_3COOH	0·01	0·0128	3·4
C.—100 c.c. 0·04N $Ca(OH)_2$ 25 c.c. N/1 CH_3COOH	0·02	0·0241	3·8
D.—200 c.c. 0·04N $Ca(OH)_2$ 25 c.c. N/1 CH_3COOH	0·04	0·0240	4·4
E.—200 c.c. 0·04N $Ca(OH)_2$ 25 c.c. N/1 CH_3COOH Solution not boiled.	0·04	0·0212	4·4
F.— 25 c.c. M. $CaCl_2$ 25 c.c. N/1 CH_3COOH	($CaCl_2$ — 0·35 % CaO)	none	2·8

It appears from the above results that in concentrations of calcium hydroxide of 0·02 per cent. CaO and over, pectin is precipitated very nearly quantitatively. It is necessary, however, for the solution to react alkaline for a certain time in order to saponify the pectin to calcium pectate.

No precipitation occurs at much greater concentrations of CaO if the solution at one period does not react alkaline (see experiment F). The precipitation of pectin from alkaline solution has not yet been studied. The few experiments recorded above only constitute a preliminary study of the subject of the precipitation of pectin.

APPLICATION OF THE LABORATORY EXPERIMENTS TO FACTORY PRACTICE.

1. *The effect of superheating acid juice.*—Very little of the pectinogen contained by the *bagacillo* in the juice should be extracted at temperatures up to 120°C. The laboratory results showed that rather less pectinogen is extracted at this temperature by acetic acid of the same hydrogen ion concentration (pH 5) as raw juice than by water (pH 7). Certainly not more, possibly less pectinogen should be dissolved from the fibre by heating juice at natural acidity, though from the experiments recorded the amount of dry substance extracted at 120°C. is slightly greater than by heating the fibre with water at 98°C.

2. *The precipitation of pectin.*—Only in those processes where an alkalinity (to phenolphthalein) obtains should the precipitation of pectin as calcium pectate occur. In both the single and double carbonatation processes, and in sulphitation

processes where milk-of-lime is added before sulphuring, the precipitation of pectin should be complete. The effects of more alkaline clarification as recently practised in Hawaii have been described by McALLEP.[1]

3. *Adding lime in the maceration.*—Laboratory experiments have demonstrated that lime dissolves no pectinogen from cane fibre. However, the amount of pentosan extracted by weak calcium hydroxide (pH 8·8) may be greater than that extracted by acid juice or by water. At 120°C. this was not found to be so. No experiments have been made at lower temperatures.

4. *Presence of methyl alcohol in rums.*—In view of the presence of methyl alcohol in alkaline extracts of cane fibre, the explanation of VON LIPPMANN[2] of the occurrence of methyl alcohol up to 8·5 per cent. in some West Indian rums which he ascribes to the presence of fine *bagacillo* "rich in pectic substances," is probably correct. The saponification of pectin, however, occurs far more readily in alkaline than in acid solutions. It was shown in the previous report that turnip pectinogen on prolonged boiling with water underwent partial saponification with the evolution of methyl alcohol.

5. *The removal of bagacillo.*—In so far as the *bagacillo* contains pectinogen, xylan ("cane gum") and possibly a hemicellulose, all liable to be extracted during manufacture, its removal as quickly as possible by means of strainers or centrifugals is most important. The above substances are colloidal, rendering the syrups and molasses viscous, and preventing the crystallization of sugar. In addition, the presence of *bagacillo* is conducive to the growth of bacteria with the possibility of losses by inversion and destruction of sucrose.

GENERAL CONCLUSIONS.

From a short study of the pectinogen in cane fibre (in which it is present up to 1 per cent.), it appears that different methods of clarification should not extract widely differing amounts of the pectinogen contained by the *bagacillo* in the mill juice.

Precipitation of the pectin will not occur unless the juice is limed alkaline. At present it is impossible to state the quantity of pectin that may be removed from solution by adsorption at the surface of kieselguhr, or substances precipitated *in situ*, such as calcium sulphite and calcium carbonate in the sulphitation and carbonatation processes. In a previous report some results were given of the adsorption of pectin by "Norit" carbon.[3] Further work is required to study the soluble pectin of the juice and its precipitation at different H-ion concentrations. The precipitation of xylan will also be studied, and an attempt will be made to isolate the hemicellulose of the cane.

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The American Sugar Refining Company has lately been going to law to enforce contracts for the purchase of sugar made with them just prior to the slump in sugar prices in 1920. Two wholesale firms of grocers in Brooklyn have been successfully sued for damages and costs arising out of contracts to purchase sugar at 22½ cents per lb which were afterwards repudiated. In each case the defendants were members of the Greater New York Wholesale Grocers Association, an organization which has contested the 22½ cent contract claims since 1920.

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[1] *La. Planter*, 1923, 70, 268. [2] *I.S.J.*, 1921, 331.
[3] *I.S.J.*, 1923, 251.

Removal of Scale from Evaporators with the Use of Ammonium Fluoride.[1]

By Dr. T. Van Der Linden.

Analyses of Evaporator Scales and Syrup Deposits.

During the past campaign in some of our factories much trouble was experienced by the rapid scaling of the evaporators, especially in the last two cells. Analyses were made of the scale from the fourth cell of the two quadruples (one large and one small) at Garoem factory, as well of the deposit in the syrup coming from the evaporators. and also of the deposit in this syrup after sulphitation, the figures (per cent. dry substance) being the following :—

Scale from the Evaporators.

	Quadruple A. (small one.)	Quadruple B. (large one.)
Silica, and insoluble in HCl	45·92	47·75
Iron and aluminium oxides	1·20	1·41
Calcium oxide	25·70	25·30
Sulphuric acid (SO_3)	8·47	1·86
Phosphoric acid (P_2O_5)	trace	trace
Organic matter (loss on ignition)	17·53	18·99
Undetermined matter (alkalis, etc.)	1·18	4·69

Deposit from the Evaporator Syrup.

	Syrup before Sulphitation.	Syrup after Sulphitation.
Organic matter	44·90	47·10
Ash	55·10	52·90
This ash consisting of :		
Silica, and insoluble in HCl	74·45	65·76
Iron and aluminium oxides	8·94	16·54
Calcium oxide (CaO)	11·13	15·53
Sulphuric acid (SO_3)	trace	trace

It may be remarked that the scale could be removed only by boiling out with caustic soda ; also that the deposit was separated from the syrups by centrifuging and washing with water, the quantity amounting in both cases to 400–500 mgrs. per litre.

Origin of the Scales and Deposits.

Examination of these four analyses immediately shows that silica and silicates are present, besides organic matter, as the principal constituents. It might be supposed from this that one is here dealing with particles of mud that had escaped into the evaporators as the result of the faulty drawing-off of the settling tanks, or of the cloudy-running of the filter-presses. Against this idea, however, it must be pointed out in the first place that at no time was trouble experienced with the colour of the sugar; while as further evidence, it may be stated that the incrustation was present in the last cell as a hard, difficultly removable scale on the tubes, which points to it being a deposit from solution, rather than a precipitate from a suspension. Moreover, faulty drawing-off of tanks, and cloudy-running of presses, results in the fouling of the first bodies; while, last but not least, practically no bagasse particles could be detected microscopically in the deposits, which would not have been the case if mud constituents were concerned.

[1] Abridged translation from *Verslag der Vergaderingen van de Vereeniging van Adviseurs bij de Java-Suikerindustrie*, 1923, 4, No. 4, 174-177.

It would consequently follow that the silica and silicates in the scale and in the deposits must have been present originally in the juice, either in ordinary or in colloidal solution; so that here we have to do with an abnormally strong silica and silicate deposition, as in fact occurs to less extent in all factories. Two questions arise: (1) How one can best clean such rapidly fouling evaporators; and (2) how one can prevent the occurrence of the scaling.

SCALE REMOVAL, USING AMMONIUM FLUORIDE.

In regard to the first question, a fortunate discovery occurred during the 1919 campaign at the Tegowangi factory where great trouble had been experienced in the removal of the scale from the 3rd and 4th cells. On one occasion, it was found after boiling out that the scale from the 4th cell was present on the tubes as a somewhat gelatinous mass, which offered no trouble in its removal. Although it was stated that the work of boiling out had been conducted as ordinarily, investigation showed that among the drums of caustic soda which had been used, one containing ammonium fluoride had been present. Experiments confirmed the deduction that ammonium fluoride actually had a solvent action on the scale; but at the time nothing further was done in the matter, seeing that at that time ammonium fluoride was a very expensive product.

Later, however, at Djatiroto a 4th cell was boiled out with a mixture of caustic soda and ammonium fluoride, and this factory reported as follows regarding the test: "During the last clean-out of the evaporators, an experiment was made with ammonium fluoride, about 800 kg. of caustic soda and about 50 kg. of ammonium fluoride being added to the last cell of 488 sq. m. of heating surface. The scale became thick, soft, and readily removable; whereas that in the 3rd cell, which had been treated with the same quantity of soda, had a thin, hard scale, difficult to remove."

What the effect of the ammonium fluoride is, we do not know, though we suspect that it acts on the silicates, converting them into a gelatinous mass throughout the scale. At any rate, next time the evaporators were being cleaned at Garoem an experiment in boiling out with this substance was made. Cells 1 and 2 of the large evaporator there (the four cells of which have heating surfaces of 475, 260, 260, and 260 sq. m.) were boiled out with the ordinary dose of caustic soda plus 15 kg. of ammonium fluoride, the 3rd and 4th each also receiving 35 kg. of NH_4F. The small evaporator was boiled out only with caustic soda; and in both cases the operation lasted 12 hours. Directly after discharging the liquors, the cells were filled several times with water, held full of water as far as the tube-plates, and scraped wet. So easily could the scale from the large evaporator be loosened, that it was not necessary to work with scrapers; in fact, drawing a steel brush through the tubes was sufficient to make them absolutely clean. All four cells were clean after 14 hours' scraping, whereas formerly this work took 36 hours. On the other hand, in the small evaporator, the scale was as difficult to remove as usual, and took 12 hours.

COST OF THE FLUORIDE TREATMENT.

Now the question is the extra cost of this treatment. Altogether, 100 kg. of ammonium fluoride had been used, the price of which a few weeks ago was f. 1·60 per kg., on which basis the additional cost of the evaporator cleaning at Garoem was f. 160. As advantages of the method, one must consider the shorter scraping, the less injury done to the tubes, and the certainty of a clean evaporator. But there is the possibility that this cost may be much reduced by lessening the quantity of caustic soda, and in two of the factories of the Koloniale Bank,

Mr. Loos added to the ammonium fluoride only so much caustic soda that during boiling out the liquid remained distinctly alkaline. In a fourth cell of 246 sq. m. of h.s., 25 kg. of ammonium fluoride and 35 kg. of caustic soda were used. Two hours boiling sufficed so to loosen the scale that scraping was very easily accomplished.

In the Garoem tests mentioned above, the caustic soda used was 1·5 kg. per sq. m. of h. s. If, in connexion with the result just mentioned, this quantity can be brought down to 0·15 kg., then this means a saving of soda for the fourth vessel of about 350 kg., representing f. 91 at 26 cts. per kg. If only ammonium fluoride were added in the third and fourth cells, viz., 70 kg. at a cost of f. 112, then against this there would be a saving of f. 182 for 700 kg. of caustic soda. A further economy should be obtained by replacing ammonium fluoride by the somewhat cheaper sodium fluoride, provided the same effect be obtained. But this might not be so, since the development of ammonia may be one of the active factors.

Therefore, in another experiment at Garoem, the two last cells of the two evaporators were again boiled out, but with less caustic soda, and using ammonium fluoride in the third and sodium fluoride in the fourth cell.

Cell.	Heating Surface.	Treatment.
No. 1	475 sq. m.	675 kg. of soda.
,, 2	260 ,,	375 ,, ,,
,, 3	260 ,,	75 ,, ,, + 30 kg. of NH_4F.
,, 4	260 ,,	55 ,, ,, + 35 ,, NaF.

It was reported to us that the scale was very easily removed by scraping in the first and second cells; that in the third it was soft and easily scraped; but that in the fourth it could hardly be removed. Yet from this experience one should not draw the conclusion that sodium fluoride cannot replace the ammonium salt, for the experiment requires repetition. Still, it is shown that one can work with a lower dose of caustic soda. Commercial ammonium fluoride is slightly acid, and it may probably suffice to remove this acidity. In this last cleaning there were used in the large evaporator 620 kg. of caustic soda less, having a value of f. 161, and 65 kg. of ammonium fluoride having one of f. 104. Hence, the amounts both of soda and of fluoride can be raised before the cost becomes the same as it was formerly when using the soda alone in larger quantity.

Prevention of Formation of Silicate Scale.

We now come to the second question, namely, how the deposition of such scale can be prevented. It is known that the solubility of calcium silicate diminishes as the acidity of its solution increases, and that silicic acid is more readily separated at higher degrees of acidity; so it was decided to sulphite to a somewhat higher degree than usually in the fore-factory, the acidity being raised from 30–35 to 60–70 mgrms per litre. After adopting this higher degree of acidity, the evaporators were less readily fouled than before. Furthermore, in the following cleaning of the evaporators the ammonium fluoride treatment had no longer the particularly striking result as at first, so that we are strongly inclined to assume that the greater sulphitation had really effected a diminution of the silica and silicate scale, although the deposit in the treated syrup still made its appearance.

Discussion.

In a discussion following the reading of the above paper, Mr. H. Schweizer said that he could not imagine what reaction was exerted by the ammonium fluoride on the silica and silicates, though perhaps one of the other halogen salts, sodium chloride or ammonium chloride, could be used.

Mr. H. Schmidt remarked that he was impressed by the possible economical advantages of such a method of dealing with evaporator scale, but that he could not explain theoretically the action of ammonium fluoride, though perhaps an ordinary double decomposition was concerned. He had boiled out small quantities of scale in the laboratory with caustic soda and ammonium fluoride in weak concentration, and had found that 51 per cent. had gone into solution, of which figure 73 per cent. was silica. Then he had repeated the same experiment with caustic soda and sodium chloride, when 50 per cent. went into solution, 71 per cent. of which appeared to be silica. There being little difference between the two results, possibly common salt may be used to replace ammonium fluoride.

Recent Work in Cane Agriculture.

Report on the Operations of the Department of Agriculture in the Madras Presidency for the Official Year 1921-22.

The present report, from this southernmost part of British India, contains an interesting map indicating the development of the Agricultural Department. The Presidency is divided into eight agricultural circles, each of which is placed in the charge of an experienced agricultural officer, with a large number of subordinates. The charges are however of very large area, and the ground is by no means covered; the average cultivated area in each circle is slightly under 5,000,000 acres. There are 16 agricultural experimental stations situated in tracts differing materially from one another in climate, soil and the crops grown, while there is considerable variation in the races of cultivators and the language spoken. In six or seven of the stations sugar cane is grown. The kinds of cane are all of the thick tropical variety, as the Indian indigenous forms are of little economic value in this area under strictly tropical conditions. On the map the cultivated area in each circle is represented in a diagram, in which all crops grown to the extent of 1 per cent. of this area are indicated; and it is significant of the size of these tracts that only in one circle is sugar cane represented in the diagram, with an area of 47,000 acres. Rice is the principal crop in the coastal circles and dry cereals of the millet class in the inland ones. Sugar cane, which is always grown under irrigation, cannot be cultivated unless there is a good supply of water all the year round, and such conditions are rare in India, except in small areas which are very widely scattered.

Varietal tests of sugar cane are carried out regularly on some of the stations as well as, by co-operation, on the ryots' fields. The present favourites, at any rate in the north of Madras, appear to be J 247 and "Java," a fine cane which has been so long in the country that its proper name has been lost, as well as all trace of its introduction. Red Mauritius is widely spread in all parts. All of these varieties were introduced to the notice of the cultivators through the Samalkota Sugar Station. Of J 247, which has gained in popularity during recent years, it is recorded that about 100,000 sets were distributed in the northern circle as "very disease-resistant and adaptable to different soil conditions." The Sindewahi furnace from the Central Provinces appears to be making considerable progress through demonstrations on various stations.[1]

The time honoured nitrogenous manure in the best cane fields of this part of India is castor cake, a slow-acting manure which requires abundant water for its proper disintegration. Owing to the diminution of the growth of this crop in India during recent years castor cake has risen very considerably in price, and experi-

[1] Described in *I.S.J.*, 1921, page 173.

ments with "fish guano" which is potentially available in large quantities have shown that the cake may be replaced by the guano without loss in yield. Nitrate of soda and sulphate of ammonia have been generally found to be unsuitable to the conditions. Propping of canes has been found necessary in those parts which are visited by cyclonic winds during the ripening of the cane, and the use of galvanized wire in place of bamboos has proved satisfactory and is likely to be more economical. This method recently described in this Journal[1] was devised by the officer in charge of the Cane-breeding Station at Coimbatore. The Report of the work on that station is unfortunately not included in the Madras Report as it is supposed to deal chiefly with North Indian conditions, nor has it as yet found a place among the Government of India's publications.

At the Central Farm at Coimbatore further experiments have been conducted on testing the ripening of the cane by the refractive index of the juice, minute quantities being taken from the different joints by a modified hypodermic needle. The results indicate that "the cane ripens joint by joint and if samples when taken from the top and bottom joints show refractive indices the ratio of which is close to unity, the cane is at the most suitable state for cutting; if the ratio is below this, the cane is not matured, and if it is much above this, the cane is over ripe. If these results are confirmed, as they seemed likely to be, this will form a useful method for adoption in experimental work on cane. The results further indicate that the coefficient of purity is not a reliable criterion upon which to judge the ripeness of cane, as has been generally supposed."

On the Relative Manuring Value of Sodium Nitrate and Ammonium Sulphate. *Oscar Loew. Agricultural Extension Notes, No. 59, Porto Rico Agricultural Experimental Station, Mayaguez, August, 1923.*

The author remarks that it is generally held that sodium nitrate makes a higher yield than ammonium sulphate, but that certain conditions may modify this conclusion very much; it is important for the farmer to know the conditions under which each manure is preferable. The reaction of the soil is a prime factor in the matter, and it may be stated generally that nitrate of soda is to be preferred in neutral and acid soils, while ammonium sulphate is more suitable for alkaline soils. But this general statement is subject to exceptions. In Porto Rico the acid soils are generally of a reddish colour, but turn grey when continually manured with organic matter; the alkaline soils exist in the comparatively dry region in the south of the island.

The acid condition can be improved by the application of lime and the alkaline by adding gypsum, this salt not only converting part of the sodium carbonate present in such soils into neutral sodium sulphate but also diminishing the stiffness of the soil. If however the lime content in alkaline soils is over three times as great as the magnesia, magnesium sulphate will produce a better result than the gypsum. Nitrate of soda is termed physiologically alkaline, in that it is converted into sodium carbonate in the soil when the nitrate is absorbed by the roots; similarly the ammonium sulphate although neutral in itself is called physiologically acid because, after its ammonia is absorbed by the roots, it remains in the soil as sulphuric acid.

Experiments have shown that the reaction of the manure applied has great influence on neutral soils. Thus nitrate of soda acts most favourably when coupled with acid superphosphate, because this neutralizes the subsequent alkalinity. Ammonium sulphate similarly should be mixed with basic slag; but if much calcium carbonate is present in the soil it may be used with superphosphate, since

[1] *I.S.J.*, 1923, page 304.

the calcium can be relied on to neutralize any acidity subsequently produced. Nitrate of soda may produce poor results, either when heavy rains wash it out to a certain extent, or in moist soils where denitrifying bacteria may destroy its usefulness by dissipating its nitrogen into the air. Thus in a coffee plot on the station the part receiving ammonium sulphate gave four times the yield of that manured with nitrate of soda; examination showed that the moist upper layer contained denitrifying organisms, and abundance of water is the rule in the summer in Porto Rico. This case should be held in mind when considering the manuring of citrus and sugar cane as well as coffee on heavy clay soils.

ANNUAL REPORT OF THE INSULAR EXPERIMENT STATION OF THE DEPARTMENT OF AGRICULTURE AND LABOUR OF PORTO RICO, 1921-2. *San Juan, Porto Rico, 1923.*

This Report commences, as it now usually does, with a list of officers in tabular form entertained during the fiscal year ending June 30th, 1922. The frequent changes in the personnel of the more important heads of divisions have been constantly brought to the notice of the authorities since 1918, and this matter has now become a serious problem in the working of the Agricultural Department.[1] During the year under reference, out of 16 technical investigators, only seven remained at the station during the whole 12 months. Upon examining this matter the new Director, R. MENÉNDEZ RAMOS, finds that several of the recent vacancies have been caused by the lack of proper remuneration. He reports that, by an Act of the Legislative Assembly of Porto Rico, passed on June 30th, 1921, a reduction of all salaries in the Department was decided on, ranging from 9 to 23 per cent., to take effect on July 1st, 1922, or the commencement of the new financial year. From this we presume that the resignations of the Director, E. D. COLÓN (April, 1922), the Chief Chemist, F. A. LÓPEZ DOMINGUEZ (November, 1921), and the Expert in Cane Diseases, F. S. EARLE (July 7th, 1922), may have been brought about by this retrograde decision. Considering the class of work which has been produced by these officers, this appears to be a case of lamentable short-sightedness on the part of the Legislative Assembly, having regard to the difficult position in which the sugar industry in the island has been placed on the agricultural side.

The section dealing with this matter concludes as follows:—"If the centrals and large sugar estates, even at the actual low prices of sugar, can take away from us the best professional men of our staff after they have acquired here very valuable experience, no doubt they will continue to do so in future, only more so, as their prosperity warrants. Unreasonable would it be to ask professional men who make their living by their technical work to give us their co-operation for half the salary they can draw somewhere else. Because of the said reasons it is here emphatically urged that something be done to have our investigators and men of science stay at their work with the reasonable incentive of proper remuneration."

Owing to the vacancies, through unfilled positions, $10,369.17 of the money voted for salaries remained unused. "The position of Chief Agronomist (vacated by Dr. E. E. BARKER, on 22nd of May, 1921) was unfilled throughout the entire year: the salary assigned being no doubt a very meagre incentive for the proper candidates for the position." This is sad reading when it is agreed on all hands that the chief present need of the sugar industry in Porto Rico is the introduction and popularizing of improved methods of cultivation. It is of course also obvious that much of the devoted work of the investigators of the pests and

[1] *I.S.J.*, 1920, p. 73; 1921, pp. 610-611; 1923, p. 301.

diseases which appear to be present in such full force in the cane fields of the island, although of great scientific interest, is likely to be of little practical value to the industry, until this fundamental matter is attended to.

Leaving the question of salaries, and passing to the budgets of the various services, one meets again and again with the remark "the appropriation is obviously too small," and actual sums expended in carrying out the sanctioned programme have to be met from various other sources. The list of investigations carried out during the fiscal year is of great interest, and several of them are of first-class importance, and it is doubly unfortunate that some of the most valuable of these have been carried through by workers who have now resigned, and are no longer available for carrying on these investigations.

Owing to the late appearance of this report, most of the papers dealing with the outcome of these researches have already been noticed in our columns. The most important are the following. The sugar cane varieties of Porto Rico. Part II, by F. S. EARLE [1]; Investigations in fungus diseases of the sugar cane, by JULIUS MATZ [2]; Depreciations of cane through delays in shipping and after being burnt, by F. A. LÓPEZ DOMINGUEZ [3]; Transmission of mosaic disease by insects, by G. N. WOLCOTT,[4] and by C. E. CHARDON.[4] The important work on Fertilizers of sugar cane, being conducted by the co-operation of the divisions of Agronomy and Chemistry, has been to all appearance indefinitely held up, because of the resignations of the chiefs of these two divisions. The remaining work of the experts of the Insular Experiment Station does not concern the sugar cane industry, and is consequently of less general importance to the island because of the dominant position of sugar among the exports.

CRITICAL PERIODS IN THE GROWTH OF THE SUGAR CANE CROP. *M. Koenig. Bull. 27, General Series, Department of Agriculture, Mauritius. Port Louis, 1923.*

This bulletin, prepared by the Statistician attached to the Department of Agriculture in the island, records an attempt to determine whether there are any distinct periods, during the growing season of the sugar cane, when rainfall and temperature are of special influence on the amount of the ultimate crop reaped. The data used are (1) the mean rainfall and the number of rainy days during successive months over a series of years at 27 stations scattered over the island, and (2) similar means of temperature, average and maximum, obtained from the records at the observatory at Pamplemousses, as well as the accumulated temperature, commencing with November, for each successive month of the year up to August. Complete data of temperature are not available elsewhere at present, but it is pointed out that, as the conditions affecting the relative temperature in the various parts of the island are, to all intents and purposes, similar, the absence of records from other stations is probably of less importance than in the matter of rainfall.

The method adopted is, naturally, mathematical; correlations are determined by the use of coefficients, and are controlled by the probable error in each case. But a short description of the principles involved in these methods is given for the benefit of those who are not accustomed to their use. The correlations worked out are, as regards rainfall, those between the average falls in individual months over the period between 1904 and 1921, and also between the number of rainy days in each month as indicating the comparative wetness of the atmosphere, and the crop of sugar produced each year during the same period. As regards tem-

[1] *I.S.J.*, 1922, pp. 236-239, and 350-353. [2] *I.S.J.*, 1923, pp. 424-427 and 537-539.
[3] *I.S.J.*, 1923, pp. 539-540. [4] *I.S.J.*, 1923, p. 596.

perature, on the other hand, the correlations studied are between the average mean monthly temperature, the mean monthly maximum, and also the accumulated heat from November onwards to each month of the normal growing season, and the sugar obtained.

In each case the rainfall and temperature are correlated separately, in that, for rainfall the influence of temperature is eliminated by an appropriate formula, and for temperature the influence of temperature is eliminated. And the results appear to indicate very definitely that these factors at certain periods of the year dominate the ultimate crop obtained, whatever variations occur at other times. In other words, in the experience of the island, the rainfall and temperature are usually sufficient for the production of the cane crop, excepting at certain critical periods during growth, when because of occasional deficiency the crop is markedly diminished.

The conclusion arrived at is that, in spite of the scanty material available, "it is believed that a few tolerably well-indicated points have been arrived at in the analysis.

(*a*) There are, in the growth of the sugar crop of this island, treated as a whole, several critical periods, during which the action of certain meteorological factors exercises a permanent effect.

(*b*) So far as rainfall is concerned, there are two critical periods, viz., November-December and June-July. At other stages of the growth of the cane the effect of the rain can be compensated, but, during the critical periods, abundance or deficiency in rainfall produces a permanent effect on the crop.

(*c*) So far as temperature is concerned, high temperatures are important at all times in the growth of the cane, but most important, in general, during the month of March, this month being thus a critical one as regards temperature."

The author looks forward to the time when the meteorological returns now commenced will be available from more localities of a typical nature, and considers that it will then be possible to select those varieties which seem to be best adapted to the special conditions of the climates studied; he remarks that the importance of meteorological factors on the yield of crops was recognized many years ago and was summarized in the adage "Annus fructificat, non tellus."

COIMBATORE SEEDLING 205 (Flowering Variety). *Malik Sultan Ali. Leaflet No. 22 of 1923. Department of Agriculture, Punjab.*

This presents the official view, after several years' trial on the local Experiment Station, of the merits and demerits of a new seedling cane introduced from Coimbatore into the Gurdaspur Circle of the Punjab. This tract lies about one thousand miles to the north west of Bihar,[1] while the Shahjahanpur tract recently referred to[2] is about half way between the two. The whole of this area is thickly planted with sugar cane and in the main comprises the North Indian sugar cane tract, for which these seedlings were designed.

The parentage of Co 205 is given as "a thick tropical cane crossed by *Kahi*." The latter is the local form of *Saccharum spontaneum*, here a pestilential weed in the fields.

"The seedling has the following merits:—(1) It grows vigorously and successfully on most soils and under most climatic conditions. It does well even on poor soils and in dry years: its superiority over the local canes in bad years is particularly marked. (2) It is a tall thin cane with long sets and a hard rind. This renders it less susceptible to attacks of disease and wild animals, and having a deep root system it does not easily lodge or suffer from drought. It requires somewhat less irrigation than do ordinary canes. (3) Best of all, it is a heavy yielder. Three years' experiments at Gurdaspur farm show that, cultivated

[1] *I.S.J.*, 1923, pp. 229-231 and 242-246. [2] *I.S.J.*, 1923, pp. 423-424.

barani, it gives nearly 50 per cent. more gur than do local canes. On irrigated land, experiments at Gurdaspur, Lyallpur and Hanai farms for two years give an increase in yield of nearly 20 per cent.

It has the following drawbacks:—(1) It ripens somewhat late, (2) the cane is harder than the ordinary ones and therefore requires more power to crush, and (3) the juice is thinner and the percentage of sucrose somewhat less than in ordinary canes. These drawbacks are, however, much more than compensated by the increased yield per acre and the variety can be confidently recommended to cultivators especially on *barani* soils. It generally comes into flower, but this should in no way alarm the people."

Considering that there are some 400,000 acres of sugar cane in this tract, over 90 per cent. of which is planted with Katha, the thinnest and most primitive cane variety in India, the rapid spread of this and other Coimbatore seedlings seems likely to be assured.

ANNUAL REPORT OF THE CANE-BREEDING STATION AT COIMBATORE, FOR THE YEAR ENDING MARCH, 1922.[1]

Owing to its late arrival, the scientific details of this Report have to a large extent been referred to already, but the following additional notes appear to be worth recording. The flowering season appears to have been unfavourable to the raising of fresh seedlings during the year, but abundant work was afforded by the study of the very large number planted out in the previous season, namely 11,000. Pollen studies appear still to be carried on and the former findings regarding the possibility of keeping it viable for a lengthy period have been checked and substantiated. The difficulty in this work has always been that sugar cane pollen refuses to germinate in ordinary pollen nutritive solutions. This has been confirmed, it is stated, by workers in Cuba, where the stigmas of the tobacco plant have proved to be a satisfactory medium. This is interesting in that, after many experiments, the wild Datura was called into requisition some years ago, at Coimbatore, and its stigmas are in regular use on the farm. The tobacco plant and Datura both belong to the same natural family, the Solanaceae.

The raising to maturity of 11,000 seedlings for testing their juice is a somewhat formidable task, and we are not surprised that it has been found necessary to alter the established seedling routine on the station. Hitherto the new seedlings have been planted out as soon as they were sufficiently advanced for preliminary observations to be made on their relative vigour, namely when about three to four months old. But at this time (March to April) water is very scarce and, besides this, with such large numbers, the value of the preliminary examination is somewhat doubtful in that the time allowed is too short. Towards July-August the water difficulty is removed and in the district a subsidiary planting season, detached from the ordinary milling season, is in vogue. Advantage has been taken of this to wait till this time for the planting out of the seedlings selected. Another advantage obtained is that there are thus two analysing periods, so that this important work can be less hurriedly gone through and, further, that by short-planting the original seedlings are not planted out finally but cuttings are obtained from them. It is hoped, by the introduction of this new method, that some at least of the abnormal vigour of seedlings will be ruled out.

References are made as to the behaviour of the seedlings sent out to various parts of North India, but these have been mentioned elsewhere. The subject of extending the work of the station and including the raising of seedlings for the parts of India suited to thick tropical canes is also referred to, but no definite steps appear to have been taken in this direction.

C. A. B.

[1] As mentioned elsewhere (page 641) this Report is not printed, but we have received a typed copy with permission to comment on it.

Report on Labour-Saving Devices in Hawaii.[1]

General Observations on Cane Loaders.

Mr. H. L. Freeman, of the Holt Manufacturing Co., wrote :—Loading cane consists of three operations : (1) arranging the cane so that the loader may operate on it ; (2) conveying the cane to cars or wagons ; and (3) elevating the cane into a transportation unit. Any cane loader must perform one of these operations before it may be seriously considered. A machine capable of performing the second operation of loading cane is of prime importance with railroad transportation methods. The first and third operations, principally the first, are of vital importance in both wagon hauling and fluming.

The first operation will probably never be performed by machine. In a boom-type loader the cane must be bundled and placed in slings or other receptacles by hand ; while conveyor loaders of the endless belt type require that the canes be placed on the belt by hand. It is wrong from an efficiency standpoint for the cutter to drop the cane haphazardly, if by a reasonable modification of methods he can leave it in condition for the loader to begin operations on it directly. I believe this can be done. Senator Baldwin suggests that five cutters could work together, two on each side throwing to a centre row. This would leave a windrow of cane which he believes could be picked up by a sort of tong arrangement, somewhat on the principle of a clamshell dredger. Even though this only picked up 75 per cent. of the cane (he believes it would handle a higher percentage), the remainder could be collected and disposed of as a separate operation. He has actually experimented with the tong arrangement and is convinced of its feasibility. On account of the irregularities of the ground, the stones and trash on it and the varying size, shape and weight of the canes themselves, there does not seem to be any practical way of picking the individual canes from the ground mechanically.

The second operation is of great importance as most of the cane raised in Hawaii is transported by rail. Surface conditions make it very difficult to transport an endless belt type conveyor long and heavy enough to serve 75 ft. and elevate its load into cars, besides a belt type loader discharges in such a disorderly manner that car capacity cannot be maintained, which unfavourably affects operation all the way to the mill and back to the field again. There are left the alternatives of picking up the cane in bundles and swinging them through the air as a boom, or throwing it into a receptacle, such as a box and picking the box up with a lifting device on a tractor and running the tractor to the car, or pushing or dragging a bundle on the ground. All of those methods have objections. But the third operation is a relatively simple one and may be accomplished by any of the standard methods of elevating bundles of material. The one feature to keep in mind is that the cane must be delivered in such condition that cars can be easily loaded to 3½ tons. By careful working cars can be loaded to 5 tons.

Wilson-Webster Loader.

This type is actually in daily use at Ewa Plantation. It accomplishes operations 2 and 3. The cane is hand-bundled in a light pipe rack, made in halves, the sling lying on the ground until the bundle is completed when the sling is hooked up and the pipes pulled away and used to form another bundle. These bundles weigh 500 lbs.

[1] Summary of a Report by Mr. W. A. Ramsay, Acting Chairman, Labour-Saving Devices Committee, Hawaiian Sugar Planters' Association, Honolulu, T.H.

The entire machine is on four car wheels running on the portable railroad; but, as it sits in one place some hours, the corners are blocked up to the ground to add stability. Temporary rails run from the body of the loader to the portable track, and the cars pass through the body of the loader, motive power for moving the cars being furnished by a pair of mules. The engine and clutches are arranged along the sides of the machine, the operating levers and booms being arranged on a top deck. Four drag lines run from the carriers of the loader. These are carried out by men, 200 ft. (maximum), and two bundles dragged to where the boom can reach them. This machine loads 13 to 14 cars per hour, using 40 to 45 people, mostly women, at a cost of 80 cents per ton, including cutting. The usual cost of cutting and loading is about 62½ cents to 65 cents per ton at present bonus percentage.

PIONEER TYPE.

This machine is limited to operation 3. It is an endless belt type, the conveyor about 30 ft. long and 24 in. wide, being mounted on a Caterpillar "45." The conveyor is a canvas belt with square shafts rivetted to the inner face of the belt, the ends of the shaft being turned to carry small wheels running on a track; the whole is driven by a chain running from a stationary attachment in front to a shaft alongside right of crankcase, and thence back to opposite the rear flywheel and up to conveyor frame. Although several of these have been built, the idea seems fundamentally wrong. The machine is very limited in its performance of operation and, furthermore, delivers the cane into the cars end first, so that they cannot be well loaded.

PAWLING & HARNISCHFEGER EXCAVATOR.

This is an excavator of the boom type, carried on Caterpillar tracks and performs operation 2 and 3. The machine carries a 38 ft. boom and is capable of a maximum lift of 3500 lbs. at 38 ft. radius. The boom is very slow lifting, being carried on double rigging. It swings quite rapidly; but the controls are not sensitive, and much time is lost in spotting loads over cars. A demonstration of this machine handling 1800 lb. bundles was given; and though the general principle seems sound enough, it was clear the machine was too heavy and clumsy to use on a cane loader. This machine teaches that every movement of the machine must be under the perfect control of the operator and made at high speed.

THE WALSH CANE LOADER.

Mr. E. J. WALSH wrote :—The first loader was built as an experiment and used on the 1921 crop. After practical field operations covering a period of three months, it was decided that the machine had considerable merit and that the idea was beyond doubt practical.

As it now stands the loader consists of a conveyor constructed of steel, 5 ft. 9 in. wide and 31 ft. long, mounted on a 1-ton Ford truck. The conveyor is pivoted on a differential pedestal which permits it to be tilted up or down and swung all or partly around. The power is taken from the engine which drives the truck, thereby eliminating the necessity for two power units. To facilitate moving over furrows, water courses, portable track and level ditches, we have constructed a tractor tread and attached same to the rear axle of truck, which takes the place of the rear wheels. This feature has in every way proved successful. At the top of the conveyor we have provided a hopper, which catches and holds the cane until a certain amount has been deposited, it then automatically dumps the load into the car. There is a deflection board under the hopper which tends to distribute

the cane evenly on the car. This hopper device has not proved altogether satisfactory; and, as it is a most important feature, especially in loading into open or stake cars such as are used here, we are now working to improve it for the next crop. In briefly summing up the results obtained, the poorest day's work done was 4 tons per man in 8½ hour day with new Filipinos; and the best day's work was 8·1 tons per man in 7½ hour day with Japanese. On this day the tracks were spaced 165 ft. apart. In figuring the results obtained, the operator is in every case included. In every instance, except one, the men worked by the day, but were paid the amount of their average earnings per day or contract work for the preceding month. On the trial when the men were paid their regular day rate, the cost per ton, including gasoline and oil, was 24 cents. The average cost, however, throughout totalled 39 cents per ton.

The machine is simple, light (weighing about 5000 lbs.), inexpensive to build, easy to run, low in operating cost, and requires 30 per cent. to 40 per cent. less portable track in harvesting than is required by hand labour, and consequently less replanting is required. One handicap at present is the open or stake car used. We are, however, determined to construct the machine so that it will successfully operate on this type of car, feeling that by so doing it will be an easy matter to load into side door cars.

THE FRITSCHI-HUGHES CANE LOADER.

Mr. L. D. LARSEN wrote :—The loader was first put into the field at the end of June, and handled the cane at the rate of 1 ton per man per hour with green Filipinos. This, however, was not continued for more than a few hours at a time due to break-downs and stoppages of various kinds. The best we were able to do continuously and on a separate area was a 6·8 acre piece of Badilla cane, the results being as follows :—Total cane loaded, 205 tons; total men on loading, 33; total men on track ahead of loader, 7; total men, 40; total tons per man per day, 5 tons.

As these men were Filipino day labourers at $1·00 per day, the loading cost per ton for labour alone came to 20 cents. Added to this would be gasoline, oil and engine tender at $6·57, this making the total cost $46·57 or 22 cents per ton. The above figures include considerable time lost by stops and by having to run up several short track lines on one side across over same and go down the other side. Since these trials were made, several changes have been made on the loader and when our mill starts again we expect to use the loader as a regular harvesting unit.

THE WALSH *v.* THE FRITSCHI-HUGHES.

Mr. W. A. RAMSAY said that the Walsh loader is decidedly superior and more advanced than the Fritschi-Hughes. The two are very similar in general principle and seem to have about the same capacity. While there are certain features of the Fritschi-Hughes loader that could be used to advantage on the Walsh loader, the latter as a whole is undoubtedly the better constructed machine, and we believe should be developed in preference to the Fritschi-Hughes. Both of these loaders have demonstrated their ability to load cane economically. Both are still capable of a great deal of development.

It remains to be seen, of course, whether this or the boom type of loader is the more economical. Very probably both types can be used to advantage under special conditions and neither one nor the other need necessarily become the universal type of cane loader.

The Economic Situation in Java.

(Department of Overseas Trade Report.)

The British Commercial Agent for the Netherlands East Indies at Batavia has just prepared a detailed Report on the economic situation of the Netherlands East Indies to June, 1923. The following excerpts relate to sugar and its subsidiary industries.

Sugar.—Events in the Java sugar market have moved so rapidly that at present the trade is more concerned with the 1923 crop and early speculation in the 1924 crop than with the output of the past year; it is therefore only necessary to review very briefly the main feature of this trade in 1922.

The 1922 crop.—At the end of March, 1922, the estimated production for that year for all mills affiliated to the Vereenigde Javasuiker Producenten (Java Sugar Growers Association) was 24,163,994 piculs, of which 12,092,569 piculs had been sold forward.

During April and May the market was dull, and mostly confined to second hand dealings. The first fillip to the trade came in June, when it was estimated that the visible world's stocks of sugar was 2,317,680 tons against 3,179,806 tons in the preceding year; this pointed to an improvement in the market position, as the world consumption of sugar was in no way diminishing. At the end of June, Cuba quotations had risen by $3·25, and regular and large orders were coming in for Java sugar. The market during the month was, therefore, buoyant and the United Java Sugar Growers' Association sold 6,800,000 piculs during that month, and increased their price limit to 13·00 guilders, per picul for superior head sugar, 10·50 guilders for head sugar No. 16 and higher, and 10·25 guilders for Muscovados, while their total sales for all grades had, by this time, reached 19,569,441 piculs.

When there was news that the Formosa crop, which was originally estimated at 400,000 tons, was only supposed to realize 250,000 tons, immediate bids for Muscovados for Japanese account came in, while British India also came forward as a considerable buyer of the higher grades, with the net result that in the first week of August the Association, who now had only a small amount of the 1922 crop to dispose of, again increased their limits for superior to glds. 14·00 and for second boilings to glds. 14·24 per picul.

A sharp reaction set in shortly after the middle of August when the American Senate passed a new tariff on sugar, which amounted to $2·30 for foreign sugar, with a polarization of 96° and $1·84 for sugar from Cuba with the same polarization. The reaction, however, did not last long; by the end of October Cuba quotations had again gone up by $3·75 and British India again came in for the second time with large orders for Java sugar, so that by the end of November the Association had disposed of the whole of the 1922 crop at prices very little below the limits fixed in August. The final figures reached a total of 26,084,987 piculs.

Interest in the 1922 crop has since been confined to second-hand dealings, and all holders of sugar stocks have benefited by the increased prices now current.

The 1923 crop.—Interest in the 1923 crop was first noticeable in August last, when enquiries for Superior and No. 16 were received by the Growers' Association, who then fixed their limits for these grades at glds. 13·25 and glds. 12·00 per picul respectively. After lower bids had been refused the first 980,000 piculs of the 1923 crop was sold on August 9th at the limit prices. In October further parcels of the forward crop were sold, but as so few enquiries were being received the limit prices were temporarily reduced to glds. 12·75 for superior and glds. 11·75 for No. 16, while the limit price for Muscovados was now fixed at glds. 11·00 per picul. From October to the end of the year the demand for the 1923 crop was steady, and by December 31st the Association had disposed of 13,865,400 piculs. Prices for the better grades had by this time risen to glds. 13·50 for Superior and glds. 12·25 for No. 16, while there was a strong demand for Muscovados at glds. 12·00 a picul.

The current year opened with a brisk demand for sugar, and second-hand parcels were being sold locally at steadily rising prices; the Association, however, continued to sell the 1923 crop at glds. 13 for Superior and glds. 12 for No. 16 up to February 4th, 1923, when they announced that all further bids would be refused and fixed no new limits. This created a mild boom in the local market, and second-hands were sold as high as glds. 14 for Superior and glds. 13 for No. 16; at these prices the trust again opened, but the general tendency was towards still higher prices, and glds. 17 per picul for Superior was offered and accepted. At the end of February the Association fixed their price limit at glds. 17 per picul for Superior and glds. 16 for Muscovados, but even higher prices were now obtainable, so that the last parcels of Superior 1923 were sold at glds. 19 per picul before the end of April.

Second-hand dealing in the 1923 crop is extemely brisk, and it is generally expected that the world-wide demand for sugar will be maintained, so much so that great interest is already evinced in the 1924 crop. The latest available record of the total sales of the 1923 crop is 24,471,097 piculs, and as the total production during the current year is estimated at 26,500,000 piculs, it will be seen that the extent of forward sales has been reached with a minimum margin of safety.

The 1924 crop.—Although the 1923 crop is not yet harvested, considerable forward buying of the 1924 crop has taken place, for which the trust have fixed the minimum prices, which will be accepted at the time of writing (May 10th, 1923) as follows:—

	Guilders per Picul
Superior Head Sugar	16·50
No. 16	15·50
Muscovados	15·50

while 8,810,905 piculs have been sold forward.

In view of the extraordinary demand for the 1923 crop it is of interest to record the principal first-hand local buyers as follows:—

	Piculs.
Japanese firms	9,642,620
European firms	7,718,556
Chinese firms	4,871,551
British Indian firms	2,232,440

Machinery and Accessories.—During 1922 there was little demand for engineering requirements. The principal consumers are the Government workshops and other services, sugar factories, agricultural estates, and the smaller repair shops and similar enterprises which are mostly Chinese-owned. The Government restricted all expenditure of not immediate necessity, sugar factories and estates undertook a certain amount of repairs and renewals, but their requirements were below normal, and the Chinese waited for bankrupt stock which could be bought in at less than half their original cost. The net result is that imports during 1922 show a very heavy decrease.

Many engineering firms became involved in financial difficulties and were glad to clear their stocks at any price; bankrupt stocks were constantly thrown on the market, while firms who were in a favourable financial position and able to buy new stock and thus take advantage of the lower prices at which engineering goods could be obtained from European countries, were afraid to make heavy purchases lest they should be undersold by further lots of bankrupt stock consequent upon fresh failures. It is therefore better to draw a veil over the chaos existing in the engineering market of this country during the past year and consider future possibilities which are decidedly brighter.

The better prices obtained for produce have encouraged estates to undertake further renewals of their engineering plant and to buy new machinery in order to increase the output of the existing plant, so that some substantial orders may be expected during the current year.

For the few engineering orders that were forthcoming in 1922, Great Britain had to face strong competition from Germany, who by her low prices secured the major portion

of the orders. The position has been changed during the last few months, and Germany can now no longer supply at a price which defeats all competition, and orders during the current year are being again placed with British exporters of machinery. Every trade factor is now favourable to British suppliers, and they should obtain a larger share of the engineering imports during the current year.

Chemicals and Chemical Manures.—The fact that the Netherlands East Indies is a considerable consumer of chemicals and chemical manures is now fully realized by British manufacturers, and exports to this country from the United Kingdom have been well maintained. For several of the principal lines consumed there is an increased import which has largely favoured Great Britain. Many home manufacturers previously not represented in this market have during the past two years established trade relations with leading importing firms, so that if our competitive prices are maintained there is now every indication that in future the United Kingdom will be the principal supplier of heavy chemicals.

The Price of Sugar in Cuba.

Cane Farmers' Remuneration during 1922 and 1923.

(From our Havana Correspondent.)

Below we give a Table showing the prices of sugar for the years 1922 and 1923 (to the end of September) paid for sugars in the public warehouses at the seaports of Cuba. The prices are given in cents per lb. and in Official money, which has the same value as U.S. currency, hence the subjoined figures can be read in American dollars and cents.

The prices given in the Cuban Public Warehouses are, in nearly all cases, taken as the basis on which the farmers are paid for their cane. The contracts with the farmers generally read: ". . . . that the farmer will have his sugar delivered to him in the Public Warehouse at the Seaport to which the factory hauls its sugars"; or it may be that the farmer is paid the equivalent of that sugar. In either event, the Table shows how the Cuban cane farmer fared in 1923 as compared with 1922.

AVERAGE PRICES FOR SUGAR IN THE PUBLIC WAREHOUSES AT SEAPORTS, CUBA, FOR EXPORTATION.

In Cents per lb. and without the Cost of Bag.

	1922.	Average	1923.	Average
January	1·576	....	3·235	
February	1·696	....	4·485	
March	1·951	....	5·206	
April	2·093	....	5·711	
May	2·138	....	5·893	
June	2·630	....	5·727	
July	3·207	....	4·844	
August	3·293	....	4·230	
September	3·163	....	4·639	
	——	2·416	——	4·885
October	3·233	....	—	
November	3·458	....	—	
December	3·465	....	—	
	——	2·655	—	

According to the press, supplies of home-grown beet sugar are being popularized in South Lincolnshire, a district adjacent to the Kelham beet sugar factory. Local grocers are quite satisfied with its quality.

British Guiana.

(Colonial Office Report for 1922).

The United Kingdom takes first place with 44·11 per cent. of the aggregate general trade of Br. Guiana, Canada is second with 29·61 per cent., and the United States occupies a third place with 11·29 per cent. This distribution of trade is different from the distribution which prevailed immediately prior to the War. In 1914 the Home Country had 57·40 per cent. of the Colony trade, as against 44·11 in 1922; Canada in the former year secured 20·52 per cent., as against 29·61 per cent. in the latter year; whilst the United States advanced their aggregate trade with the Colony from 10·91 per cent. in 1914 to 11·29 per cent. in 1922.

During the Great War a large proportion of trade which had formerly been by the United Kingdom was diverted to the United States, but since the cessation of hostilities trade conditions with the former country have exhibited a tendency towards gradual improvement, and there is every possibility of greater expansion, provided that the class of goods for which Britain has always been noted can be supplied on the conditions demanded by trade, as the quality of British-made goods is so well known as to place them in the forefront of the world's manufactures. Therefore, with increased production it is reasonable to expect to see great improvement in British trade in the near future.

The aggregate trade done with Canada in 1922 was slightly more than in the previous year, that for 1922 being 29·61 per cent. as against 24·22 per cent. in 1921. Of the total quantity of sugar exported during the year, 62,938 tons went to Canada, and the greater part of the balance of sugar exports went to the United Kingdom.

The sugar crop of the Colony for 1922 was 101,128 tons, as compared with 104,350 tons, the average yield of the preceding ten years. The area reaped was 53,740 acres, the average yield of sugar being 1·86 tons per acre. The returns submitted by sugar plantations in the Colony show that in 1922 60,760 acres were under sugar cane. Of this area not less than 65 per cent. was planted with the D 625 variety of cane, whilst about 11 per cent. was planted with this cane mixed with Bourbon and seedling varieties. There were only about 1500 acres planted with Bourbon unmixed with other canes.

There was a decrease of £609,317 in the value of sugar exported in 1922. The quantity was less than that exported in 1921 by 17,699 tons, the figures for 1922 and 1921 being 90,571 tons, valued at £1,494,827, and 108,270 tons, valued at £2,104,144, respectively. The quantity of rum shipped during the year was less than the exports of 1921 by 1,805,996 proof gallons, and the value was less than that of 1921 by £330,821. The exports for 1922 were 422,168 proof gallons, valued at £33,410, as against 2,228,164 proof gallons, valued at £364,231, exported in 1921; 212,565 proof gallons of the quantity exported in 1922 went to the United Kingdom.

Immigration from India remained suspended during 1922, but during the year the Colony was visited by a deputation sent by the Government of India with a view to investigating the problem on the spot and reporting whether any further guarantees in respect to the status of Indian immigrants are necessary before emigration is re-opened. The deputation stayed two months, but so far nothing has been elicited as to the nature of their recommendations to the Indian authorities.

American Commerce Reports.[1]

SUGAR MARKETS OF CZECHOSLOVAKIA, HUNGARY, AND AUSTRIA

The former Austro-Hungarian Empire was a large exporter of sugar, Bohemia being the chief exporting province. During the 1913-14 campaign the Empire produced 1,688,000 metric tons of raw sugar, of which 970,000 tons were exported, leaving for domestic consumption considerably more than the 680,000 metric tons required at the rate of 13·2 kilos per capita. This sugar was manufactured in 218 factories, 176 (or 80 per cent.) of which are now in Czechoslovakia, 13 (or 6 per cent.) in Hungary, and 7 (or 3 per cent.) in Austria, and the remainder in Poland, Rumania, and Yugoslavia.

The combined sugar production of Austria, Hungary and Czechoslovakia in the season 1922-23 was approximately 50 per cent. under that of Austria-Hungary in 1913-14.

Comparison of the Sugar Industry in 1913-14 and 1922-23.

Countries and years.	Area planted. *Hectares.*	Raw Sugar produced. *Metric tons.*	Imports *Metric tons.*	Exports. *Metric tons.*	Consumption. *Metric tons.*
1913-14:					
Austria-Hungary	431,000	1,688,300	—	970,000	680,000
1922-23:					
Austria	11,563	24,463	66,966	—	91,420
Czechoslovakia	182,849	733,825	—	360,702	271,929
Hungary	43,061	81,603	*9,506	2,536	88,563

Czechoslovakia as a Beet-Sugar Producer.—Not only does the Republic of Czechoslovakia have most of the sugar industry of the former dual Empire, but it is second only to Germany in the beet-sugar production of Europe. It is estimated that more than 400,000 metric tons will be exported this year, as compared with 360,702 tons for 1922-23. This is due to the increase in acreage of 20 per cent. over the preceding year and 13 per cent. over the 1920-21 season. A total of 219,480 hectares have been planted this year.

Production in Hungary.—Since 1920 Hungary's sugar industry has made much progress. The production during the campaign of 1922-23 was 48,275 metric tons more, or an increase of 145 per cent., as compared to that of 1920-21. The area planted this year is 56,104 hectares, which is a 30 per cent. increase over 1921. It is expected that Hungary will be able to export more sugar this year than last, as the result of the increase in acreage and the good crop prospects.

Austrian Consumption Exceeds Production.—During the season 1920-21 Austria produced nearly 15,000 metric tons of raw sugar, which was only 12 per cent. of the normal requirements. But in the 1922-23 campaign (September to May, inclusive) Austria has increased production to 24,500 metric tons, or 20 per cent. of the normal consumption. Within the past two years the beet acreage has been increased 124 per cent. and the raw sugar production 65 per cent. However, Austria will never be able to produce enough sugar to supply its own demands and will have to import the excess. At present approximately 80 per cent. of the sugar imported comes from Czechoslovakia.—[Trade Report, October, 1923.]

SUGAR PRODUCTION AND CONSUMPTION IN PARAGUAY.

A recent report on Paraguayan production of cane sugar issued by the Banco Agricola indicates that the average production of the six plants now in operation in the country is about 3240 metric tons annually. There are ten plants in the Republic, the largest of which has a capacity for the production of 3000 metric tons per year but actually produces about 1700, while the five other plants now operating have a comparatively small production ranging from about 60 to 500 metric tons per annum. The total capacity of the ten factories is put at 6060 tons.

[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here. * 1922.

Cane Acreage and Average Yield.—The total acreage of cane varies from year to year between 12,000 and 17,000 acres. The section of the country best adapted to the cultivation of sugar cane with respect to soil, climate, and means of communication is said to be that district lying in the vicinity of the River Tebicuari and along the railway line from Ybitimi to San Pedro del Parana. The other districts favourable for the cultivation of cane are those near Asuncion, the sections lying near the River Jujuy, and in the district of Concepcion in the north, and along the upper Parana.

The varieties cultivated at present are limited to the cane from the Province of Tucuman, Argentina, and the average crop varies from 20 to 30 tons per acre, depending upon the prevailing conditions of soil and climate. The sugar produced is white with coarse grains, like that of Brazil and Cuba. There are no special refineries.

Production Consumed within Republic.—The consumption of sugar in the Republic exceeds the production of the home industry by close on 1000 metric tons. A large part of the product is utilized in different parts of the country in the manufacture of liquors and molasses for local consumption. The deficit is met by importations, largely from the near-by Provinces of northern Argentina. The only reasons for the failure of Paraguay to produce sugar in sufficient quantities to supply local demand are, perhaps, the lack of capital and the uncertainty of labour. However, it is probable that in course of time production will be increased to the point where importations will no longer be necessary. [Consular Report, October, 1923.]

Sugar Production of Portuguese East Africa for 1923.

Sugar cane crushing began in July in Portuguese East Africa, and the prospects were excellent for an increased production this year. The ample rains of the past season, though resulting in some damage through flooding, on the whole stimulated the growth of the cane, and an excellent yield is indicated. Furthermore, extensive new areas are just coming to maturity, and the cane will be cut for the first time this year.

The official estimates for the production of the different estates are shown below. These estimates, however, represent the most conservative figures, for they are the basis on which are apportioned the quantities which each Company is obliged to contribute to the supply of Portugal and to the Province itself.

Estates.	Metric Tons.
Sena Estates—	
Mopea	11,000
Marromeu	12,000
Caia	8,000
Companhia do Buzi	8,000
Fabrica de Nhamacurra	400
Mutamba Estates (Inhambane)	200
Incomati Sugar Estates	6,000
Movene Sugar Estate	350
Total	45,950

It is believed that the total production for the year will be close to 60,000 metric tons as compared with 50,000 last year. Of this quantity 25,000 tons are reserved for Portugal and 1500 tons for the Province. The remainder will probably be shipped to the United Kingdom and the Continent. Hitherto, the most of the sugar has gone to the Transvaal and the Union of South Africa, but the termination of the Mozambique Convention has closed that market to local producers. The European prices, however, are good and the companies are preparing to extend their production in every way possible.

The British Syndicate which was recently investigating the prospects of starting a sugar central in St. Thomas Parish, Jamaica, has apparently been unable to secure the purchase of the necessary properties, and it is feared that the scheme has been abandoned, at any rate so far as that location is concerned.

Publications Received.

Industrial Filtration. By Arthur Wright, M.E. First Volume of the Modern Library of Chemical Engineering. (The Chemical Catalog Co., Inc., New York, U.S.A.) 1923. Price: \$5·00.

Another book on filtration has been published[1]; and, judged from several criteria, as value of information given, skill in collation of material, clarity of descriptions of apparatus, and excellence of illustration, a very good book it is. It is particularly well put together, since, to make the mass of technical data easy to read and to understand, outline form is followed almost throughout. In the main the book is divided into three parts: (1) The Theory of Filtration; (2) the Mechanics of Filtration; and (3) Filter Practice. Under the theoretical heading, clarification, cake building, cake washing, cake drying, cake discharging, filter media, theory of filter application, and auxiliary equipment, are discussed, this section being really a development of several laws of filtration, based on standard practice, that is, largely on certain "tricks of the trade," which have gradually been acquired as the result of the experience of workers in different industries. Under the "Mechanism of Filtration," modern industrial apparatus is described, e.g., bag filters, plate-and-frame presses, suction leaf filters, pressure leaf filters (Kelly, Sweetland and Vallez), rotary vacuum filters (e.g., the Oliver, American continuous, and "F Einc" apparatus) is given in each case under such headings as history, design, operation, advantages and disadvantages, applications, and the like, which makes easy reading of the descriptions of the several types easy, and indeed little could be said in the way of criticism of them. Lastly, on the third part, there is a comparatively brief account of the applications of industrial filters to representative materials; the relation of filtration to chemical engineering operations, such as drying, evaporation, crystallization, decolorization and distillation; and plant practice, that is, materials of construction, control, and interdepartment co-operation. There is a good deal of information in this book bearing on filtration in the sugar industry, in which it would appear the author has had some experience. What he has to say on cake building and washing, on the value of filter-aids, and in particular the application of kieselguhr, is well worth perusal, apart from his data on the construction and use of bag filters, plate-and-frame presses, and pressure leaf filters. Mr. Wright's work will be found particularly useful as a textbook for students, though there is much theoretical and practical information which will be found valuable to the plant engineer for the better understanding and better operation of the processes of filtration with which he is concerned.

Betterave et Sucrerie de Betterave. By E. Saillard. Third Edition, entirely revised. Part II. (J.-B. Ballière et Fils, Paris.) 1923. Price: 16 fr. 50.

Part I of this book, dealing with methods of analysis and chemical control, has already been noticed[2]; and this second volume deals with the cultivation of the beetroot, and the extraction of sugar from it, according to modern French practice. Appended to it is a list of the apparatus (including capacities) composing a modern beet sugar plant, as suggested by a Committee appointed to consider the reconstruction of factories in the devastated regions of France.

The Modern Theory and Practice of Pumping. By Norman Swindin, A.M.I.Mech.E. (Ernest Benn, Ltd., London.) 1923. Price: 35s. net.

A treatise on the application of the Reynolds-Stanton law of viscous flow to modern pumping problems, and the flow of liquids through pipes. Industries directly faced with pumping problems will find the new data and formulæ contained in this work a direct help to more economical and more efficient working.

[1] See also *I.S.J.*, 1923, 601. [2] *I.S.J.*, 1923, 39.

Brevities.

It is reported that the first operations of the Ruckstuhl continuous clarifier[a] at Raceland factory, La., have been highly successful. It is stated to have operated at full capacity, and to have settled the juice rapidly and completely, meeting every claim of its inventor.

Lord Denbigh, in a letter to the *Daily Mail*, reports that in Czecho-Slovakia skilled engineers or machinists earn the equivalent of 6½d. per hour for an 8-hours day. The labourers in the sugar beet fields earn 8 kronen per 10-hour day. This at pre-war rates would be equal to 6s. 8d. per day, but at the present rate of exchange is about 1s. 1d.

The Mauritius Legislative Council has agreed to give preferential treatment to a substantial extent on all imports not affecting essential foodstuffs, being products of the United Kingdom and of such British Dominions and Colonies as may reciprocate. This is a *quid pro quo* for the considerable measure of protection the Home Government propose to grant British sugar on entry into the United Kingdom.

The consumption of sugar in the Netherlands has developed very considerably during the last two decades. In 1901 the consumption was 67,000 metric tons, or 28·2 lbs. per head. In 1914 this had increased to 100,300 tons, or 35·5 lbs. per head; in 1919, the first post-war year, to 161,893 tons, or 52·2 lbs.; while in 1922 the consumption was 179,903 tons, or 56·5 lbs. per head, the consumption having thus doubled since 1901.

Reports from the Netherlands indicate that the beet sugar crop is disappointing in that the roots are small and their sugar content on the low side. Although 25 per cent. more was sown, the production will remain below last year's, and is not expected to exceed 200,000 to 210,000 tons, against 235,000 tons last year and 346,000 tons in 1921. The average sugar content is only 15·25 to 15·5, which is 3 per cent. lower than was recorded at the end of October, 1922.

The first installation of the Petree process in a sugar mill in the Argentine Republic is being made at Ingenio Concepción, Tucuman, for the 1924 season, beginning next May. This ingenio is considered one of the largest and most progressive factories in Argentina. It possesses two mills with a combined capacity of 3500 tons of cane per diem. With the installation of the Petree process, the present system of open defecator, filter-press clarification will be discarded.

According to a correspondent of the *Times*, the German Government is proposing, in order to obtain foreign exchange, to allow the export of sugar. In connexion with this proposal a *canard* took shape that Germany intended to export two million tons of sugar. Considering that last year's home requirements were only just met by production, any, even moderate, export this season is likely to produce a shortage later on, which can only be met by importing sugar next year.

A very interesting straining apparatus (named the "Auto-Klean") has recently been put on the market in London, the object of which is to eliminate the drawbacks of gauze and operate more or less in an automatic manner. In this device, the straining is accomplished on the principle of passing the liquid through a series of fine slots in the wall of a cylindrical cartridge formed by a pile of circular discs mounted on a central spindle and interleaved by thin washers, the thickness of which is a measure of the straining required. Suspended matter is intercepted by the edges of the discs, which in course of time become coated with a coat of precipitate or slime, as in the case of gauze. In order to clean the cartridge slots, all that is required is to give a handle situated at the top or end of the apparatus one-third of a turn, the dirt thus being scraped from the slots, and carried clear of the cartridge face, after which it settles to the bottom of the strainer, collecting in a sump from which it may be withdrawn. Although the "Auto-Klean" device (which in principle is similar to the Hele Shaw "Stream Line" filter) has not yet been applied to the straining of mill juices for the separation of *bagacillo*, according to reports it has dealt very effectively with very viscous fluids, such as oils. In place of the handle mentioned, use may be made of a ratchet slow worm gear, in order to provide a continuous cleaning action. It would appear to be an apparatus worth consideration by the sugar factory engineer.

[a] *I.S.J.*, 1923, 502.

Brevities.

There are signs that the depression in Chile in the production and export of nitrate is now much less acute than during the past few years. Heavy purchases have lately been made in different quarters, principally by American cotton planters, and the European trade also gives signs of improvement. In fact, it is reported that the industry is approaching its normal pre-war production, in spite of the keen competition on the part of synthetic nitrate and sulphate of ammonia.

Composite nitrogen and phosphoric acid fertilizers are generally made by treating superphosphate with ammonia; the resulting product being a mixture of ammonium sulphate and tricalcium phosphate, in which latter form the P_2O_5 of course is hardly available. C. MATIGNON[1] has elaborated a method of manufacturing a dry composite fertilizer containing 4·1 per cent. of nitrogen and 11·95 per cent. water-soluble phosphoric acid, 76 per cent. of the total phosphoric acid being soluble in water, and therefore immediately available. This product is called "Superam."

According to WILLETT & GRAY, the price to be paid to beet sugar growers who supply Maffra State sugar beet factory next season has been fixed at 37s. 6d. per ton guaranteed. Growers will receive an additional 1s. per ton for every increase of £1 in the price of sugar beyond £37 10s. realized on this season's output. The new price is smaller than last year, when 42s. 6d. per ton was paid. But the sugar then realized £49 per ton. The price has since fallen to £42. It was expected that the price would recede to £35 in October, hence the reduced price to the grower.

Dr. C. A. BROWNE, the new Chief of the Bureau of Chemistry, Washington, was requested by the Great Western Sugar Co., of Denver, Colorado, to give an expression of opinion on the merits of beet sugar, and replied in the following words: "As between sugars of equal purity and equal physical characteristics there can be no difference, there should obviously be no prejudice on the part of the consumer against either the product of the sugar cane or the sugar beet. Owing to lack of experience in the early days of the industry in the United States, a certain amount of inferior beet sugar found its way into the markets, and the prejudice then created in the minds of certain consumers although largely dispelled with improvements in manufacture, has occasionally persisted among the misinformed."

Before the Chemical Engineering Group of the Society of Chemical Industry, Prof. J. W. HINCHLEY recently read a paper[2] on the great possibilities offered by leucite, which occurs in immense quantities in lavas in Italy. It contains 21·5 per cent. of potash; 23·5 per cent. of alumina; and 55 per cent. of silica. Dr. VOELCKER finds that, when applied as a fertilizer in fine powder, it is practically equivalent to soluble potash of the same composition. Its potash can be extracted from it by treatment with acids, making possible the production of alum, for example, at about £4 per ton; while the silica separated may be converted to sodium silicate (1·38 sp. gr.) at about £2 2s. per ton. Potassium chloride may also be made from it very economically. Exploitation of this source of raw material is now being undertaken by the Societa Italiana Potasa, which development is stated seriously to threaten the Strassfurt industry.

In an address delivered recently to the North-western Section of the Institute of Transport, Mr. MARSHALL STEVENS, the managing director of the Port of Manchester Warehouses Limited, dealt with the methods of storage adopted in the warehouses under his control. He said that when they first started to store sugar they were told they must under no circumstances stack it more than five bags on end high. This belief undoubtedly arose in part from the fact that the old warehouse room was only 7 or 8 ft. from floor to ceiling, and only five bags high could be man-handled to advantage; it was, however, thought that the bags would burst if stored higher. This belief was so strong that only war-time exigencies enabled the Manchester warehouses to break through the convention. Nowadays they are storing sugar bags 60 to 70 bags high one on the top of the other on the flat, to the great advantage of economy of space. The sugar is worked in and out of the warehouse by electrical rubber-belt conveyors in conjunction with electrical stackers working to 30 ft., all capable of operating reversely. Man-power is only required at the wagon and on the pile. It may be added that the Manchester Docks warehousing arrangements are about the finest in the world, and their methods of storing cotton have been copied by the New Orleans harbour authorities.

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[1] *Chimie et Industrie*, 1923, 10, 216–217.
[2] *Chemical Trade Journal*, 1923, 73, No. 1905. 608–610.

Review of Current Technical Literature.[1]

VACUUM PAN STEAM COILS. *J. G. Van Ham.* *Archief, 1923, 31, No. 13, 285-286.*

Assume that a marble is allowed to run from *A* to *B* through the coil in Fig. 1 (which narrows from top to bottom), and that it takes a certain time *t*; further that the same marble is sent from *B* to *A* through the coil shown in Fig. 2 (which widens from top to bottom) and that it takes *t'*. Then, the initial velocity of the marble being the same in both cases, $t > t'$. Again, assume that the coil in Fig. 1 is placed in a tank of juice while steam passes through from *A* to *B*, and that after 60 mins. the temperature rises from *T* to *T'*; further that the coil in Fig. 2 be used to heat the same quantity of the same liquid from *T* to *T'*. Then in this latter case less than 60 mins. will be required. Condensed water is more easily removed in the "widening" coil than in the other, an actual heating test showing the difference to be 15 per cent. Now, the author asks, why is it that pans are made with coils of the form shown in Fig. 1? Difficulties of construction and bad circulation cannot in his opinion be stated as reasons, and he considers that a pan having a bottom as sketched in Fig. 3 should prove quite satisfactory. Such a construction would be cheaper, at any rate so far as the heating system is concerned, since the total length of serpentine would be shorter than in the "narrowing" form. In fact, in the case of a pan of 250 h. l. (corresponding to about 20 tons of dry sugar) having a total heating surface of about 100 sq. m. (about 1080 sq. ft.), six coils would be necessary if they had the ordinary form shown in Fig. 1, but five would suffice to give the effect if they were made as in Fig. 2 (the diameter of the coil in both being 6 in.).

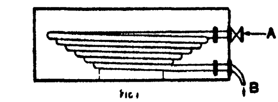


FIG. 1

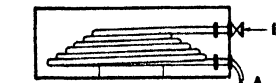
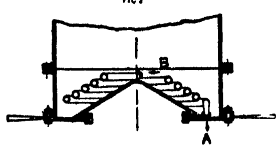


FIG. 2



EVAPORATING SYSTEMS IN ELECTRICALLY DRIVEN FACTORIES. *G. W. Connon.*[2] *Facts about Sugar, 1923, 16, No. 8, 150-152.*

Figures are presented with the object of showing the reduction of steam consumption possible with various arrangements of evaporating and heating apparatus in an electrically driven factory as compared with one operating with steam power throughout, employing a "straight quadruple effect evaporator" (in which the juice heaters use exhaust steam). A factory grinding 2,500 tons of cane per day, and macerating to make the amount of diluted juice equal to 110 per cent. of the weight of cane is considered. The total exhaust from both turbo-generators and mill engines should not be more than 55 per cent. of the steam required for heating and evaporating at "straight quadruple effect," and boiling to sugar, and may be only 45 per cent. under favourable conditions. Usually the shortage is made up by blowing live steam into the exhaust system, and if the amount of this exhaust can be reduced there will be a corresponding reduction in the amount of fuel required at the boilers. By heating the cold juice by means of vapour taken from the first cell of the quadruple, the total amount of steam required from the boilers is about 170 B.H.P. less than for the straight quadruple arrangement, while with a straight quintuple the saving would be 210 B.H.P. A further large economy in steam can be effected by the use of a pre-evaporator, to the calandria of which sufficient live steam is supplied to produce enough exhaust to make up the deficiency in the rest of the house. In this way, therefore, this amount of evaporation is performed at practically no expense, for, if this same amount of steam had been passed into the exhaust system, either directly or through the turbines, it would not have performed any evaporation. A single effect pre-evaporator, used in conjunction with a quadruple which has a large first cell for heating the juice, will give a

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] Chief Engineer, Honolulu Iron Works.

total saving of 325 B.H.P., compared with the straight system; while, when a single pre-evaporator with a quintuple effect which furnishes vapour from its second cell for juice heating is used, the figure becomes 555 B.H.P. An incidental advantage of evaporation on these lines in an electrically driven factory is the reduction in the size of the condensing plant, which, in the case of the arrangement last mentioned above, is more than 30 per cent. Furthermore, since in a straight quadruple factory the power required to operate the condensing system is usually 33 per cent. of the total power consumed in the factory, exclusive of the milling plant, there is thus in the example cited of an electrically driven factory a reduction of 10 per cent. in this total power.

PRACTICAL HINTS ON THE PRODUCTION OF GOOD PLANTATION WHITE SUGAR IN JAVA. *Ch. A. Benjamins. Archief, 1923, 31, No. 9, 199-201.*

Complaints have been received of the quality of certain shipments of the Java grades S.H.S. and S.S.S. made during 1922, black specks and small yellow lumps being present. It is explained that in nine cases out of ten the black specks are attributable to the sugars first produced during the campaign, which are held over for a time and later on mixed with the better qualities, the expectation on the part of the manufacturer being that the few sacks of bad sugars when incorporated with many of a better grade will escape the observation of the purchaser. It is remarked that this practice must be discontinued, for all should co-operate to uphold the high reputation of Java sugars on the world's markets. All discoloured sugars should be returned into process again. At times in the beginning of a campaign some days may elapse before all the particles of rust and the like are eliminated from the apparatus, and in order to obviate the difficulties under discussion, and to allow the product to arrive at the desired standard, one should work in the following way: Syrup is drawn from the evaporators at 20–24°Bé. (36-43°Brix); half strikes are boiled from it in all the pans, or grain is formed in one or two, and cut over to other pans, the massecuites thus obtained being spread over the whole content of the coolers and subsequently worked up in the ordinary way. In the case of a factory having a capacity of 14,000 piculs (850 tons) one would obtain in this way about 800 to 1000 piculs (49 to 61 tons) of sugar, which afterwards is remelted in water or clarified juice, filtered, and sent to the evaporators, the treatment of the whole being spread over about seven days. As to the cost of the apparatus, necessary for this remelting process, this is comparatively small, the following being necessary: A tank of 1 to 2 cub. ft. capacity provided with a stirring gear; and one filter-press having an area of cloth of 20 sq. m. Coming now to the cause of the presence of the yellow lumps in the sugar, this may be ascribed to the careless steaming-out of the pans, lumps left behind being mixed with the next massecuite, or to lumps in the clear syrup used for pugging, which naturally can be prevented by sieving through centrifugal gauze. In order to avoid complaints of an insufficient colour standard, the grain of massecuites should be formed only from pure evaporator syrup, and only when the crystals have attained a certain size may syrup be used, which condition is especially essential in the manufacture of S. S. S. grade.

CLARIFYING FRUIT JUICES, USING KIESELGUHR. *W. V. Cruess. Chemical and Metallurgical Engineering, 1923, 29, No. 9, 351-353.*

It is stated that filter practice (particularly from the point of view of the fruit juice industry) has been revolutionized by the use of filter-aids, the most important of which is kieselguhr, the addition of only 0·25 to 1 per cent. by weight greatly facilitating the filtration of most fruit juices, since it yields brilliant liquors without impairing the flavour. This material is more readily applied in presses than in vacuum filters or in bags. Centrifugal clarification, using a small Sharples machine operating at 15,000 revs. per min. was found effective in removing coarse suspended matter, but did not produce a brilliantly clear liquid, which could only be obtained by filtration with the aid of kieselguhr. Clarification by the use of finings (casein and egg albumen) was not as successful as filtration.

Simplified Methods for the Examination of Beet Factory Products (Sugar in Lime Cake, Steffen Waters, Saccharate Cake, Molasses, Water in Pulp, Gums in Diffusion Juice, Preparation of Standard Acid). *H. K. Lindfors. Industrial and Engineering Chemistry, 1923, 15, No. 10, 1046-1048.*

Sugar in lime-cake.—Herles' method gives good results ordinarily, but in factories in which the Steffen process for exhausting molasses is used the amount of caustic lime in the cake is comparatively high; it is therefore necessary to make the concentration of the normal lead acetate solution 250 grms. in 1000 c.c. (instead of 200 grms.), and also to add 1–2 c.c. of glacial acetic acid per litre. *Sugar in Steffen waste and wash-waters.*—Transfer a double normal weight of the water to a 100 c.c. flask; add two drops of phenolphthalein indicator; run in slowly (while constantly shaking) a concentrated solution of slightly acidified normal lead acetate (450 grms. acetate and 2 c.c. of glacial acetic acid per litre) until the red colour disappears; add about 2 c.c. more of this solution to break up the milky precipitate; complete to the mark; filter and polarize. *Sugar in saccharate cake and solution from cooler.*—These materials contain too much caustic lime to be completely decomposed with lead acetate, but by ending the reaction with this solution the danger of an excess of acetic acid is avoided. To the normal weight of the material add dilute acetic acid till the red colour imparted by a couple of drops of phenolphthalein disappears for the first time; complete the decomposition by an excess of the acidified concentrated lead acetate solution mentioned above; filter and polarize. *Sucrose and raffinose in molasses.*—Herzfeld's double polarization method gives results far from satisfactory with Steffen house molasses, owing to the large amounts of calcium, potassium, and sodium salts present, which neutralize part of the HCl; but Walker's modification[1] if conducted in the following manner is stated to give good results: Weigh out double the normal weight of the molasses, transfer to a 200 c.c. flask with water; add basic lead acetate until no more precipitate is formed (25 c.c. will generally be about right); fill up to mark; mix well, filter and polarise in a 100 mm. tube, which reading multiplied by two gives the direct polarization. Pipette 50 c.c. of the filtrate to a 100 c.c. flask; add 25 c c. water and 1 c.c. hydrochloric acid (40 c.c. water to 60 c.c. concentrated hydrochloric acid); insert a thermometer in the flask; heat on a water bath to 70° C.; remove the flask; introduce 10 c.c. of the dilute hydrochloric acid; stand in the air at room temperature for at least 45 mins.; cool; fill up to mark and filter; finally, add a knife-point of zinc dust; filter the solution, and polarize again. *Moisture in dried pulp.*—A distillation process, using the moisture testing apparatus originally devised for grain[2] is said to give results agreeing with the desiccation method within 0·05–0·10 per cent. in about 20 mins. *Gums in diffusion juice.*—To 5 c.c. of the juice add 0·5 c.c. concentrated HCl and 15 c.c. of 95 per cent. (by vol.) alcohol; mix well, and stand in water at about 70° C. for 15 mins.; again mix, transfer to a potash flask, and centrifuge for 15 mins., each degree on the stem corresponding to 0·04 per cent. of gum. Results thus obtained may not be correct absolutely, but the figures are of much comparative value for routine work. *Preparation of standard acid.*—Commercial borax after being twice recrystallized forms an excellent means for the verification of standard acid solutions, using as an indicator 1 grm. of dimethylamidoazobenzene in 1000 c c. of alcohol. 5 grms. of the salt corresponding to 26·2 c.c. of normal acid.

Comparative Inverting Power of the Mould Fungi concerned in the Deterioration of Raw Sugars. *W. L. Owen. Facts about Sugar, 1923, 16, Nos. 25* and *26, 519-521, 546-548.*

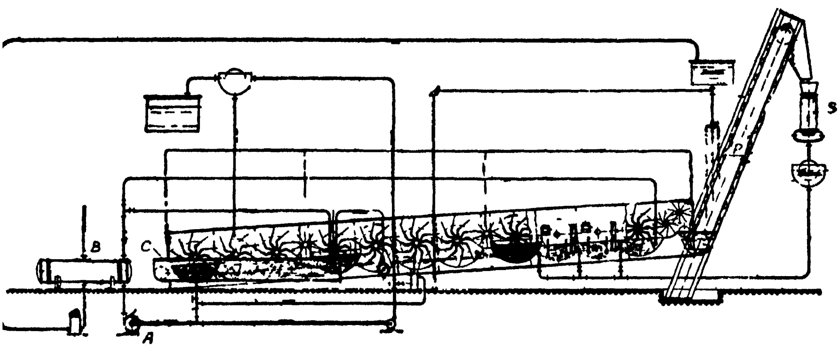
"A study of the comparative inverting power of 17 species of mould fungi, and of extracts made therefrom, shows that the comparative rank of these is practically the same. Of all the species studied *Aspergillus repens* showed by far the greatest inverting power. The extracts from some of these species were found to be capable of inverting sucrose at densities at which the mould from which the extract was made was inactive. This suggests the possibility of sugar deterioration taking place independently of the immediate activity of micro-organisms."

[1] *I.S.J.*, 1918, 289. [2] *U. S. Dept., Agric., Bureau of Plant Industry, Circular 72.*

Review of Current Technical Literature.

PHILIPP CONTINUOUS DIFFUSION PROCESS FOR THE EXTRACTION OF JUICE FROM BEETS.
H. Danckwerts. Die deutsche Zuckerindustrie, 1923, 58, No. 17, 233–234.

About 10 years ago K. PHILIPP, of Magdeburg, took out a patent[1] for a process of juice extraction from beets on the counter-current principle, and on the basis of this invention an apparatus was installed in 1920 in the Obernjesa factory, where it has been in operation since, and with very satisfactory results (it is stated), in respect both of economy and smooth working. As may been seen from the sketch here reproduced, it consists mainly of 12 troughs, arranged on an incline, each of these having a stirring mechanism for passing the slices from the lowest to the highest trough, thence to the elevator *P*, the slice-press *S*, and then out of process. In operating the apparatus; the



beet slices are introduced into a mashing tank *C*, provided with a screw conveyor, by which they are thoroughly mixed with juice at 92-95° C. taken from the first trough by means of the circulating pump *A*, and passed through the heater *B*. This hot mash then goes through the first trough, and successively through the eleven others against the current of downflowing juice, after which the partially exhausted slices are sprayed with fresh water or with press-water while passing up the elevator *P*, the final stage being treatment in the slice-press *S*. In an apparatus having a capacity of 14,000 to 15,000 centners (about 700 to 750 tons) in 24 hours, a raw juice of 15 5° Brix was obtained with exhausted slices containing 16–17 per cent. of dry substance, and about 1·5 per cent. of sugar, about half of this sugar content later being recovered in the press-water, which (as stated) goes into circulation again in the apparatus. Advantages claimed for this method of working are : Great economy of labour (only one man being required to attend to the plant); suppression of all the press-water; a minimum consumption of fresh water, (which is supplied by the excess of condensate at disposal); increase in the yield of dry exhausted slices; and lastly the ease with which frozen beets may be worked up, this in fact presenting no difficulty at all.

AMPLIFICATION OF VAN MOLL'S TABLES FOR READING THE SUCROSE CONTENT AND PURITY OF SOLUTIONS OF SYRUPS, MASSECUITES, MOLASSES, AND THE LIKE.
Th. J. D. Earle. Archief, 1923, 31, No. 35, 917 937.

In Van Moll's well-known tables[2] purities lower than 76° for solutions having a density between 15 and 20° Brix are not given, so that in examining syrups, massecuites, and other products having a lower quotient than that named it is necessary to make a calculation, this opening the possibility of error on the part of the assistants entrusted with the routine work connected with such density and polarimetric determinations. Two tables have now been compiled for the purpose of remedying this defect. In the first, the ranges for the Brix

[1] German Patent, 289,670.

[2] "Tables for the Rapid Calculation of the Sugar Quotient and Rendement." By J. F. A. C. VAN MOLL. (H. VAN INGEN, Soerabaja, Java.) Second Edition, 1915.

readings are 15 to 20° for solutions diluted 1 : 5, from which figures, and the polarimetric reading of the diluted liquid under examination, the actual polarization per cent. and the apparent quotient of purity (much below the figure of 76°), can immediately be read. As to the second table, this is on the same lines as the first, excepting that the dilution is 1 : 10. In both tables the temperature for which they are correct is 30° C.; but, provided that the observations are confined to temperatures between 24° and 35° C., the error will not be great, at most 0·3°.

DETERMINATION OF TRACES OF INVERT SUGAR IN SUCROSE FOR USE IN THE ESTABLISHMENT OF THE 100° POINT OF THE SACCHARIMETER. *I. M. Kolthoff. Archief, 1922, 30, No. 46, 867-870.*

About two years ago, KRAISY described a method[1] (using a slightly alkaline cupro-tartrate solution, and titrating with iodine and thiosulphate) for determining traces of reducing sugars in samples of sucrose; but Dr. KOLTHOFF found it to possess certain difficulties in application, so that it cannot be said to have the accuracy claimed. He recommends as preferable his modification of Summer's colorimetric procedure,[2] use being made of dinitrosalicylic acid, which in alkaline solution in presence of dextrose or levulose is reduced to a red or orange compound, the sucrose present remaining unaffected. Two reagents are required: (*A*), which is made by dissolving 2 grms of dinitrosalicylic acid in 70 c.c. of water containing 6 grms. of soda crystals, cooling the clear solution, and making up to 100 c.c., this orange-coloured liquid being kept at a temperature about 15°C., and filtered before use if it becomes cloudy; (*B*) a 4/N solution of sodium hydroxide. In operating the assay, 2 grms. of the sample of sucrose are dissolved in 10 c.c. of warm water in a wide test-tube, mixed by whirling round, and placed for 2–3 mins. in a water-bath at 70°C.; 1 c.c. of reagent *A* is added, the liquid mixed, 2 c.c. of reagent *B* added, the liquid again mixed (in both cases by swinging it round), immediately after which the tube is placed in the water-bath at 70°C., where it is allowed to remain for 8 mins. exactly. After cooling, it is run into a colorimeter tube (capacity 100 c.c., divided into c.c., and provided with a run-off cock below), made up to the 100 c.c. mark, and matched against a "blank" prepared in the same way, in the presence of 2 grms. of sucrose free from invert sugar. It was found that when 0·0025 per cent. of invert sugar is present in the sample, then the 100 c.c. of blank solution is matched by 92 c.c. of the liquid in the graduated colorimeter tube; 0·005 per cent. by 80 c.c.: 0·0075 per cent. by 69 c.c.; 0·01 per cent. by 58 c.c.; 0·015 per cent. by 45 c.c. This method is preferable to any volumetric one by reason of its greater accuracy and simplicity, but attention is called to the necessity of observing the following precautions, if constant results are to be obtained: That the amount of sucrose present be approximately the same in all tests, since its presence favours the reducing action of the invert sugar on the dinitrosalicylic acid; that precisely the volume of the reagents indicated above be added in every case; that the order of their addition be maintained; and further, that the same temperature and same time of heating be applied.

A STUDY OF THE FORMATION OF GUM LEVAN FROM SUCROSE. *W. L. Owen. La. Planter, 1923, 71, 331-333, 353-354, 373-374.*

It is concluded from a study of the levan-forming bacteria occurring in sugars that they are all derived types from the potato group of bacteria. Many of the similar species described in the literature as distinct species are thought also to be derived types. The formation of gum levan from sucrose does not depend upon the action of invertase, as implied by GREIG SMITH, but on the contrary is entirely prevented by the rapid inversion of sucrose by this enzyme. The gum fermentation of sucrose is believed to be a distinct type of fermentation, probably acquired as a means by which an organism secreting no invertase may convert the unassimilable disaccharide into assimilable forms, and into products whose combined osmotic pressure value is lower than that of the original sucrose.

[1] *I.S.J.*, 1921, 347-348. [2] *Journal of Biological Chemistry*, 1921, 47, 5.

Review of Current Technical Literature.

Bagasse, its Composition, and Decomposition (for making Paper Pulp). *Hachiro Kumagawa and Kenkichi Shimomura.* *Zeitschrift für angewandte Chemie, 1923, 36, No. 58, 414-418.*

In Formosa during the past five years the Giran paper-mill[1] of the Tainanseito Sugar Co. has continuously operated for the production, not only of packing paper, but also of white printing and writing sheets. In this article the authors discuss the composition of bagasse and of rice straw, and the results of using these raw materials for the production of various grades of paper by the ordinary processes. According to their experience, bagasse treated by the sulphite process gives a light yellow pulp, whereas Braun's sulphate process[2] and De Vains' chlorine process[3] furnish a good yield of easily bleached fibre. Rice straw, in spite of a much higher ash and silica content, was more easily decomposed than bagasse, but the yields were smaller. It is said that the high percentage of ash of the rice fibre does not affect the quality of the paper produced. Average analyses of bagasse and of rice straw, using the customary methods followed for the examination of materials used in the manufacture of paper,[4] gave the following figures (calculated on dry matter):

	Bagasse (entire).	Bagasse Fibre.[5]	Bagasse Marc.[6]	Rice Straw.
Ash	2·40	1·30	3·02	14·55
Silica	2·00	0·46	2·42	12·10
Fat and Wax	3·45	2 25	3·55	3·65
Lignin	19·95	19·15	22·30	14·84
Pentosans	24·50	26·11	29·20	20·06
Cellulose	46·00	56·60	55·40	45·42

Volumetric Determination of Sodium Hydrosulphite.[7] *S. H. Wilkes.* *Journal of the Society of Chemical Industry, 1923, 42 No. 35, 356-357T.*

This method (which may be carried out in ordinary apparatus without precautions for the exclusion of air) depends on the measurement of the H-ions produced when sodium hydrosulphite is oxidized, the hydrions being determined by their action on a mixed solution of potassium iodate and iodide, which effect is summarized by the following equation:—$3Na_2S_2O_4 + 4KIO_3 + 2KI = 3I_2 + 3Na_2SO_4 + 3K_2SO_4$. A standard litre flask is half filled with distilled water, and 6 grms. of potassium iodate and 10 grms. of potassium iodide are added and dissolved; 300 c.c. of N/10 thiosulphate solution is added from a standard pipette, after which a weighed quantity of the sample of sodium hydrosulphite under examination (about 2 grms.) is added, the flask being filled up to the mark, well shaken, and the solution titrated, 100 c.c. at a time, with N/10 iodine solution In an example, 2·0136 grms. of high-grade commercial hydrosulphite were used for the analysis, and the N/10 iodine for the titration of 100 c.c. was 72·4; therefore, the N/10 thiosulphite absorbed in the reaction was 300 — 72·4 = 227·6 c.c. Then the molecular weight of sodium hydrosulphite being 174, the percentage of the compound present is: $\frac{174}{2} \times \frac{227{\cdot}6 \times 100}{10{,}000 \times 2{\cdot}0136} = 98{\cdot}34$ per cent. This method is applicable only to preparations free from soda ash and from "decomposition products."

Methods for the Preparation of the Rare Sugars (Levulose, Dextrose, Trehalose and Melibiose). *T. Swann Harding.* *Sugar, 1923, 406-408, 476-478, 514-516.*

Previous work on the preparation of these sugars is summarized, and to this information are added the methods preferred by the writer. J. P. O.

[1] The Manager of which is the second-named author. [2] U. K. Patent, 139,171.
[3] *Chimie et Industrie*, 1922, 7, 238-243.
[4] Such as those described in Schwalbe-Sieber's book entitled "Die Betriebskontrolle in der Zellstoff und Papier Industrie" (Springer, Berlin), 1922.
[5] Long bast fibres are here designated. [6] This indicates the short parenchyma cells.
[7] See also *I.S.J.*, 1923, 271.

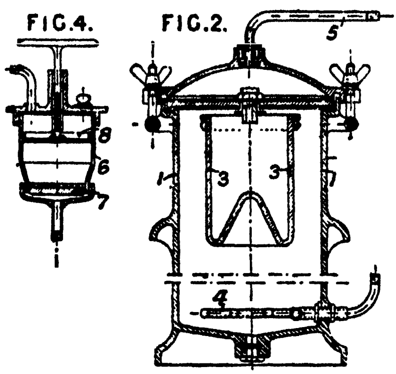
Review of Recent Patents.[1]

UNITED KINGDOM.

PURIFYING LIQUIDS AND GASES (USING DECOLORIZING CARBON). *J. N. A. Sauer*, of 2, Den Texstraat, Amsterdam, Holland. *202,654* (addition to *155,610*.) August 18th, 1923; convention date, August 18th, 1922.

Liquid or gas is intimately mingled with an adsorbing agent, and after separation therefrom is passed through one or more layers of the same or a different adsorbent. Decolorizing carbon, especially of the type which retains microscope structure of the vegetable material from which it is made, may be used. Apparatus suitable for the first step of the process in the treatment of the liquids is shown in Fig. 2. Liquid is admitted under pressure to a container *1* through a perforated pipe *4*, and is intimately mixed with adsorbing agent maintained in suspension therein. After this it passes through a candle filter *3* to an outlet pipe *5*. Container *1* may be provided with a stirring device. Later, the liquid passed downwards through adsorbing material compressed between perforated plates *7*, *8* in a chamber *6*, Fig. 4. The process is stated to be applicable for the treatment of sugar solutions, water, sewage, oils, fats and alcohols.

FIG.4. FIG.2.



FRAME FOR FILTER-PRESSES. *Alex. T. Stuart*, of Detroit, Mich., U.S.A. *185,116*. August 22nd, 1922. (Six figures; four claims.)

Claim is made for a frame for filter-presses of the type in which a plurality of spaced strips are arranged to support a filter-screen, characterized by the said strips being of thin sheet material, such as sheet metal, and spacing members arranged to support the thin strips intermediate of their length. Or the said strips may be constituted by a sheet of material folded with a plurality of folds so that the apexes of the folds present supporting edges for the screens. Thus a contact area for supporting the filtering material is provided, which is considerably less than the unobstructed filtering area.

ROTARY OR DRUM FILTER. *Edwin L. Oliver*, of Cunard Building, San Francisco, Cal., U.S.A. *200,642*. May 16th, 1922. (Ten figures; one claim.)

Claim.—In a rotary filter having an oscillatory agitator immersed in the liquid in the casing thereof, the construction of the agitator so that it is pivotally supported within the filter casing, the pivots being above the fluid level therein, the construction comprising a pair of pivots at each end of the filter, supports extending from said pivots to opposite sides of the agitator, the pivots and supports being arranged to give the agitator a substantially oscillatory movement.

PRESERVING YEAST. *Distillers Company, Ltd.*, of Edinburgh, Scotland, and *E. A. Meyer*, of Clifton, Bristol. *204,164*. July 17th, 1922.

Pressed yeast is mixed with a fatty substance of mineral, vegetable or animal origin, and is afterwards dried. In an example, 6 parts of yeast is mixed with 1 part of cocoa-butter.

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Coating the Filtering Frames of Rotary Filters with Paper Pulp. *H. A. Vallez*, of Bay City, Mich., U.S.A. *201,822.* October 26th, 1922.

A process is described for coating rotary filtering frames[1] with a paper pulp mixture, according to which the washed pulp is mixed with clear filtered or unfiltered liquid, and is circulated through the filter under pressure until a coating of the desired thickness results. When a filter becomes dirty, compressed air is introduced to break up the coating, which is discharged, and returned to the wash tank.

Prevention of Corrosion and Incrustation in Boilers, Condensers, Evaporators, Heaters, Vacuum Pans, etc. *L. Renger and W. Fuhrmann*, of Tetschen-on-Elbe, Czecho-Slovakia. *200,256.* April 25th, 1922

For the purpose of preventing corrosion and incrustation on the heating surfaces, the negative pole of a source of continuous current is connected directly to the boiler, evaporator, condenser, heater, vacuum pan, or other apparatus, and the positive pole is earthed. (Specification 153,610 is referred to by the inventor.)

Alcohol Motor Fuel. *H. Terrisse*, of Geneva, Switzerland. *202,264.* December 28th, 1922; convention date, August 12th, 1922.

Motor spirit is obtained by adding acetal, paraldehyde, or both, with or without acetaldehyde, to alcohol, to refined petroleum alone or with petrol, to the 80–340°C. fraction distilled from tar from coal, schiste, lignite, peat, or wood, or to other hydrocarbons. Examples include the use of 60 parts of alcohol or petroleum with 40 parts of paraldehyde, and of 65 vols. of coal-tar distillate with 20 vols. of paraldehyde, 13 vols. of acetal, and 2 vols. of acetaldehyde.

Manufacture of Decolorizing Carbons. *R. Adler*, of Karlsbad, Czecho-Slovakia. *202,639.* August 15th, 1923; convention date, August 19th, 1922.

According to this invention, the porosity of decolorizing carbons, such as those made from wood and bones, is increased by heating them to above 500°C. and passing over them a mixture of gases containing oxygen, the proportion of the latter being kept so low that no oxidation occurs before complete penetration by the gases of the carbonaceous material. Examples of gases which contain or which may be mixed with the necessary small proportion of oxygen are waste furnace gases, generator gas, and waste lime-kiln gases.

Retort for heating Carbonaceous Materials. *H. Nielsen*, of Muswell Hill, London, and *B. Laing*, of Hatfield, Herts. *202,738.* May 25th, 1922.

In the distillation or heat-treatment of carbonaceous and other materials in rotary retorts, the material is caused to pass through the retort at a non-uniform speed, so that it is maintained in different heat zones for a longer or shorter period, by providing the retort with internal baffles extending diametrically across the retort and of triangular section, or having inclined sides.

Continuous Extraction of Sugar from Beet, Cane, etc. *Soc. Anon. Etablissement A. Olier*, of Clermont-Ferrand, France. *203,269* (addition to *184,453*). February 6th, 1923; convention date, December 6th, 1922.

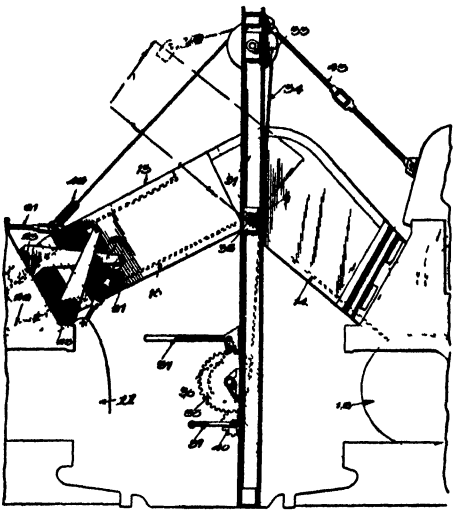
In the apparatus described in the parent specification,[2] the cross-section of the conduit and the plates of the conveyor are circular instead of rectangular and the arrangement of the conduit is modified. The branch by which the water enters is the highest, and the other pairs of ascending and descending branches decrease in height towards a branch, to which are connected the liquid outlet and the root cutter or other feeding devices. The conduit is jacketed and the first branch is cooled, the others being heated by water, steam, etc.

[1] For example, those of the filter previously described by this inventor. See *I.S.J.*, 1922, 555.
[2] *I.S.J.*, 1923, 51.

UNITED STATES.

INTERMEDIATE FEED CHUTE FOR MILLS. *Joseph Meinecke*, of Paia, Maui, T.H. *1,464,914*. August 14th, 1923.

This invention is an improvement on the intermediate chute previously disclosed.[1] Briefly described, the old structure comprises a chute generally designated *13*. The chute extends between adjacent macerating mills *11* and *12*. It has oppositely inclined portions which meet at the summit *9*. The receiving portion *15* is of less inclination than the discharge portion *14*. The receiving portion *15* has scrapers *22* which engage the discharge sides of the macerating rolls *11* so as to clean the surfaces of adhering material. Bars *23* carry the scrapers *22*. These bars also carry levers *20* which are adjustable by means of the turnbuckle rods *21*. The scrapers are set in respect to the macerating rolls *11* by adjusting the turnbuckles.



The improvement comprises standards *31* which support the chute portion *14* and to which the chute portion *15* is hinged at *32*. The standards carry a sheave *33* near the upper end of one. The strand of a wire rope *34* passes over this sheave and is fastened at the upper end of the other standard. The other end of the wire rope *34* is fastened to a drum *35* which is wide enough to accommodate a brake band *36*. This band is actuated by a lever *37*. The drum has a gear which is turned by means of the crank *39* and pinion *40*. A pawl and ratchet checks the drum *35* from counter rotation when the chute portion *15* has been elevated into the dotted line position. The bight of the rope *34* passes through sheaves *42* which are suitably affixed to the sides of the chute portion *15* near the forward end. The standards *31* are braced by tie rods *43*. The upper free ends of the sides of the chute *15* are overlapped by the sides of the chute *14* This arrangement prevents leakage, while the bagasse passes upwardly and toward the right in the chute portion *15*. The purpose of the improvement is obvious. There are times when the sugar mills must be shut down, and at such times it is desirable and necessary to clear the intermediate chute *13*. This is effectually done by elevating the receiving side *15* in the dotted line position so that all materials adhering to the bottoms and sides (which otherwise would run back into the mill *11*) may gravitate into the discharge side *14* where it will run into the mill *12*, from which it can be readily removed. The hinge *32* comprises a rod on which the chute portions are supported. The inner chute *15* is fastened to the rod; the outer chute *14* has a bearing on the same rod, so that the rod may easily turn in respect to the chute *14* which is fixed. The rod in turn has bearing on the end standards.

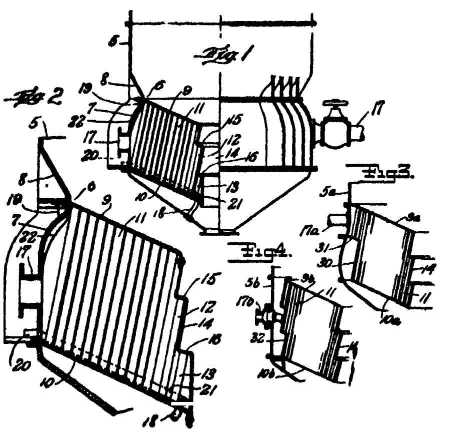
SLUICING MECHANISM FOR FILTER-PRESSES. *Sampson J. Misener*, of Woodside, Nova Scotia, Canada. *1,464,953*. (Three claims)

Claim 1.—In a mechanism of the character described and in combination, a wash-water pipe, means for oscillating it, a screw loosely mounted on the wash-water pipe, means for causing the wash-water pipe to move axially with the screw, a fixed nut engaging the screw, a pawl wheel connected to the screw, a pawl co-operating with the pawl wheel, and a pawl arm supporting the pawl and connected to the wash-water pipe

[1] U.S. Patent, 1,401,095; *I.S.J.*, 1922, 217.

Calandria Vacuum Pan, having Inclined Tube-Sheets. *Godfrey Engel, Sr.* (assignor to *Buffalo Foundry & Machine Co.*, of Buffalo, New York, U.S.A.). *1,466,367.* August 28th, 1923.

The pan shown by way of example in Fig. 1 embodies a casing *5* which differs from the usual structures of this type, in that it is contracted at a point *6* somewhat above the inclined bottom thereof, to provide a heating compartment in the lower section of the pan of materially reduced cubic capacity. This constructed portion of the casing is shown as produced by inserting a wall section *7* above the bottom of the pan, which is contracted toward its upper end to meet a correspondingly contracted portion *8* at the lower end of the adjoining section of the casing. The calandria is made up of upper and lower tube-sheets *9* and *10* of substantially conical shape, to provide inwardly and downwardly sloping or inclined surfaces, and tubes *11*, *12* and *13* between the same. A special feature of these tube-sheets is that one of them, the lower one in the present illustration, is of greater diameter than the other, so as to substantially fill up the enlarged space of increased capacity below the contracted portion of the pan. The outer edges of the tube-sheets are shown as connected together by the wall section *7* and the inner peripheral portions of the tube-sheets are shown as connected together by a down-take tube or plate *14*, stepped as indicated at *15* and *16* to take the ends of the shorter length of tubes *12* and *13*. The tubes are inclined, as indicated, downwardly and outwardly and the outermost tubes *11* are preferably arranged quite close to the outer edges of the tube-sheets, so as to provide the maximum of heating surface. Steam is admitted to the calandria through a suitable inlet or inlets *17*, provided in the outer wall of the calandria, and condensation may be taken off through a drainage pipe or pipes *18*. Incondensible gases may be taken off through upper and lower outlets *19* and *20*, the upper serving for the escape of the lighter gases and the lower for the heavier. This lower outlet may be extended by means of a pipe indicated at *21* to the innermost and lower portion of the calandria. The outer wall section *7* of the calandria may be slightly bulged outwardly between the larger and smaller ends thereof substantially as indicated at *22*, to provide a steam chest for facilitating circulation of the steam to all of the heating tubes. This invention, it will be seen, provides a maximum of heating surface with a minimum cubic content at the level where the calandria is covered by the syrup, facilitating rapid crystallization and accurate control of the operation. The increase in diameter of the pan above the level of the contracted portion provides for any desired capacity of the pan, so that without affecting the ultimate capacity, a much more efficient operation is attained than has been possible heretofore. As granulation progresses, more liquor may be admitted up to the desired high level of the apparatus, and by reason of the practically uninterrupted inclined surface of the upper tube-sheet, the magma may be quickly discharged. The steps *15* and *16* provided for the short length tubes may be inclined substantially parallel with the the upper tube-sheet, as indicated, so as to prevent the magma from lodging thereon. By arranging the parts as shown, with the tube-sheet of larger diameter at the bottom, the greatest heating surface is provided at the lower portion of the calandria and this facilitates and increases the circulation. In the construction shown in Fig. 3, the inner peripheries of the tube-sheets *9a* and *10a* are connected by a stepped shell *30*. The upper tube-sheet, as in the previous case, is connected with the casing *5a*. In this case, however, the lower tube-sheet *10a* is not connected with the casing,



but only with the shell *30*. A flange *31* extending from the step of the shell *30* is also connected with the casing. The inlet *17a*, in this case, is connected with the casing between the flange *31* and the upper tube-sheet *9a*. In the modification shown in Fig. 4, the calandria is of the floating type. In this case, the outer peripheries of the upper and lower tube-sheets *9b* and *10b* are connected by a stepped shell *32* which, as in the modification shown in Fig. 3, is concentric with the inner shell *14*, The inlet *17b* is connected with the inner shell *32* and in this modification the casing *5b* may be cylindrical. By means of this invention there is freedom of circulation and of discharge of the contents. Crystallization is effected at low temperatures and high vacuum in the lower part of the apparatus and the process may be completed in one device, instead of being necessarily interdependent upon other vacuum pans.

TREATING LIQUIDS WITH DECOLORIZING CARBON, AND SUBSEQUENTLY FILTERING. *John C. Silvester*, of Philadelphia, Pa., U.S.A. *1,469,026*. September 25th, 1923.

In the present invention, an apparatus is provided which is particularly suitable for decolorizing and filtering sugar solutions. Decolorizing carbon is thoroughly mixed therewith in a drum or mixing chamber which is provided with revolving mechanism to agitate the material in the drum and cause thorough mixture of the carbon in the solution. From the mixing chamber, the material is delivered to a filter chamber, wherein a plurality of spaced filtering elements is provided, and the liquid is adapted to pass through the outer surface of the filtering elements, whence it is conveyed to a suitable source of collection and disposal. The carbon and solid impurities originally present in the solution remain on the surface of the filtering elements, and mechanism in the form of revolving scrapers or buckets is arranged to remove the solid matter from the outside of the filtering elements. The carbon and solid material is then returned to the mixing chamber through the shaft of the drum, which is hollow, and means are provided for discharging the solid matter outwardly into the drum, whereby it is thoroughly mixed in the solution. Means are provided for heating the material to be treated during the treating operation, and for this purpose, the drum or mixing chamber may be steam-jacketed.

MANUFACTURE OF LUMP SUGAR BY COMPRESSION. *Alfred Letort and Louis Chambon*, of Paris. *1,468,242*. September 18th, 1923.

Claim 1.—A machine for compressing sugar manufactured in mass, comprising an intermittently rotatable table, a plurality of moulds spaced 90 per cent. from one another on the table, in combination with filling means for supplying sugar to the moulds, pressing means for forming lumps of regulable dimension, evacuating means for placing finished lumps upon a conveyor, and cleansing means for the pressing means, the above four said means operating simultaneously, certain of said means being controlled by an annular two-piece cam, one of which pieces is fixed with respect to the frame of the machine, while the other is movable vertically, by the operator of the machine, the movable part being carried by a sleeve slidable on a post which supports it, a manually actuated screw, means for actuating the sleeve, and screw threads on the sleeve for co-operating with the actuating means.

LUMP SUGAR PACKING MACHINE. *Guiseppe Iacobitti*, of Crockett, Cal., U.S.A. *1,472,395*. October 30th, 1923.

Claim 7.—An apparatus of the class described comprising a pivoted carton holder, cams for supporting said carton holder, means to arrange a series of lumps of sugar, means to push the sugar lumps into the carton, said means also being connected to the means for permitting the carton holder to be depressed to discharge its loaded carton, a frame carrying a plurality of spring wings arranged to be projected into the carton upon pressure of the arranged pile of lumps for preventing the arranged series of sugar lumps from catching on the edges of the carton, and means operated by the carton carrier to place said frame in a position to receive pressure from the newly arranged series of sugar lumps after one operation thereof.

APPARATUS FOR WASHING SUGAR IN CENTRIFUGALS. (*A*) ***Wm. W. Hartman***, of Los Angeles, California, U.S.A. *1,439,676*. December 19th, 1922. (*B*) ***Wm. W. Hartman***, of Los Angeles, Cal., U.S.A. *1,456,270*. May 22nd, 1923. (*C*) ***Robert A. Steps***, of Los Angeles, Cal., U.S.A. *1,423,583*. July 25th, 1922.

(*A*) Claim 1.—In apparatus for washing sugar in a centrifugal basket, an oscillating nozzle, releasable operating mechanism for the nozzle, means whereby the operating mechanism may be positively held in engagement, means for releasably holding the operating mechanism in operating position, means operated by the operating mechanism to automatically release the holding means, and means for automatically disengaging the releasing means when the operating mechanism is positively held in operative position after the releasing means has actuated. (*B*) Claim 1.—In an apparatus for washing sugar, comprising a centrifugal basket having therein a cylindrical wall of sugar, a shaft for rotating the centrifugal basket, and a spray nozzle above and to one side of the centrifugal basket; an oscillating pipe on which said spray nozzle is mounted; a cam for oscillating said pipe; a lever for establishing a driving connexion between the shaft of said centrifugal basket and said cam; means for supplying a liquid wash to said spray nozzle when said lever is actuated; and means for automatically shutting off the liquid supply to said nozzle and for disconnecting the driving connexion between said shaft and said cam. (*C*) Claim 1.—The method of washing centrifugals which consists in applying the washing fluid to the column of centrifugals in conformity to the parabola formed by superficial traces of the axial section of such column. Claim 21.—The combination with a centrifugal basket and means to revolve the same and to thereby form a hollow column of sugar to be washed, of a cam, a shaft to revolve the cam, said cam being adapted to slide on the shaft and revolve therewith, said cam being of different diameters and adapted to be shifted longitudinally of said shaft into operative relation according to the different portions of the perimeter of the cam which may be requisite to the delivery of water in proportion to the trace of the axial section of the cavity in the column of sugar to be washed.

PREPARATION OF CANE SYRUP, USING INVERTASE. ***Herbert C. Gore***, of Takoma Park, Maryland. (*Dedicated to the People of the United States for their Free Use and Enjoyment*). *1,467,599*. September 11th, 1923.

Cane or other syrup rich in sucrose at or near its original density is heated preferably to from 50–60°C; mixed with fresh bakers' yeast in the proportion of approximately 0·02 to 1 per cent. of the weight of the cane syrup; kept substantially within the temperature range specified until the desired degree of inversion has occurred; heated to boiling; and allowed to cool, thus completing the process. Usually from 15–60 hours is required, depending on the amount of yeast used, the density of the syrup, its temperature, and the amount of inversion. The greater the density, the greater the degree of inversion, and the degree of inversion required is also greater if the syrup is to be kept at winter storage temperatures. For example, in case of cane syrup of 39·3° Bé. density, the degree of inversion required for storage at 32° F. is approximately that corresponding to 60° purity of the syrup. Instead of fresh bakers' yeast the equivalent weight of air-dried bakers' yeast may be employed.

ALCOHOL MOTOR FUEL. ***John J. Murphy***, of Chicago, Ill., U.S.A. *1,471,566*. October 23rd, 1923.

Claim 1.—A fluid fuel consisting of coal oil, 40 parts; benzol, 35 parts; ether, 5 parts; and alcohol, 20 parts.

PRODUCTION OF 98-99 PER CENT. ALCOHOL. ***Joseph van Ruymbeke***, of Marseilles, France. *1,459,699*. June 19th, 1923.

Claim 6: The process of producing alcohol of strength 98-99 per cent, by bringing vapours into contact with glycerine in a rectifying column, the said glycerine acting as a dehydrating agent.

Sugar Crops of the World.

(Willett & Gray's Estimates to October 25th, 1923.)

	Harvesting Period.	1923-24. Tons.	1922-23. Tons.	1921-22. Tons.
United States—Louisiana	Oct.-Jan.	229,500	263,478	289,669
Texas	,, ,,	2,500	2,875	2,920
Porto Rico	Jan.-June	350,000	338,456	362,442
Hawaiian Islands	Nov.-July	550,000	469,000	502,194
West Indies—Virgin Islands	Jan.-June	2,000	1,739	5,000
Cuba	Dec.-June	3,700,000	3,602,910	3,996,387
British West Indies—Trinidad	Jan -June	55,000	55,000	59,948
Barbados	,, ,,	50,000	52,715	36,742
Jamaica	,, ,,	33,000	33,029	42,167
Antigua	Feb.-July	10,000	12,642	9,850
St. Kitts	Feb.-Aug.	10,000	10,735	8,426
Other British West Indies	Jan.-June	8,000	8,142	9,238
French West Indies—Martinique	Jan.-July	17,000	19,700	18,329
Guadeloupe	,, ,,	26,000	30,000	32,000
San Domingo	Jan.-June	200,000	184,171	225,000
Haiti	Dec.-June	10,000	10,000	12,283
Mexico	,, ,,	135,000	130,763	119,800
Central America—Guatemala	Jan.-June	22,000	24,445	19,090
Other Central America	,, ,,	37,000	28,000	27,972
South America—				
Demerara	Oct.-Dec. and May-June	90,000	101,128	107,797
Surinam	Oct. Jan.	10,000	11,000	10,000
Venezuela	Oct.-June	18,500	16,000	16,000
Ecuador	Oct.-Feb.	10,000	8,000	7,000
Peru	Jan.-Dec.	325,000	313,743	319,864
Argentina	May-Nov.	250,000	200,000	172,236
Brazil	Oct.-Feb.	628,000	595,723	491,933
Total in America		6,778,500	6,523,394	6,904,287
Asia—Brit. India	Dec.-May	3,000,000	2,988,000	2,532,500
Java	May-Nov.	1,720,000	1,731,875	1,649,610
Formosa and Japan	Nov.-June	400,000	405,800	406,966
Philippine Islands	,, ,,	323,000	264,000	338,160
Total in Asia		5,443,000	5,389,675	4,927,236
Australia	June-Nov.	258,000	306,678	299,465
Fiji Islands	,, ,,	35,000	25,000	71,750
Total in Australia and Polynesia		293,000	331,678	371,215
Africa—Egypt	Jan.-June	100,000	94,554	108,963
Mauritius	Aug.-Jan	200,000	231,190	197,420
Réunion	,, ,,	50,000	40,000	55,564
Natal	May-Oct.	150,000	158,221	155,194
Mozambique	,, ,,	60,000	43,000	34,446
Total in Africa		560,000	566,965	551,587
Europe—Spain	Dec.-June	12,000	13,918	13,805
Total cane sugar crops		13,086,500	12,825,630	12,768,130
Europe—Beet sugar crops		5,294,500	4,493,562	3,973,100
United States—Beet sugar crop	July-Jan.	750,000	615,936	911,190
Canada—Beet sugar crop	Oct.-Dec.	14,500	12,400	18,931
Total beet sugar crops		6,059,000	5,121,898	4,903,221
Grand total Cane and Beet Sugar	Tons	19,145,500	17,947,528	17,671,351
Estimated increase in the world's production	,,	1,197,972	276,177	935,093

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922. Tons.
Total Receipts, January 1st to November 28th	2,738,085	..	3,485,938
Deliveries ,, ,, ...	2,732,807	..	3,484,733
Meltings by Refiners ,, ,, ...	2,684,380	..	3,449,213
Exports of Refined ,, ,, ...	195,000	..	722,000
Importers' Stocks, November 28th	5,278	..	1,205
Total Stocks, November 28th..	48,044	..	38,380
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1920-21 Tons.		1921-22. Tons		1922-23 Tons.
Exports	2,104,224	..	3,594,173	..	3,386,494
Stocks	1,152,222	..	223,397	..	86,266
	3,256,446		3,817,570		3,472,760
Local Consumption	105,000	..	125,000	..	108,000
Receipts at Port to October 31st	3,361,446		3,942,570		3,580,760

Havana, October 31st, 1923. J. GUMA.—L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to October 25th, 1923.)

	Harvesting Period.	1923-24. Tons.	1922-23. Tons.	1921-22. Tons.
Germany	Sept.-Jan...	1,375,000	1,460,000	1,305,810
Czecho-Slovakia	Sept.-Jan...	950,000	733,825	659,907
Austria	Sept.-Jan...	40,000	23,976	16,322
Hungary	Sept.-Jan...	110,000	81,603	74,898
France	Sept.-Jan...	510,000	490,360	306,073
Belgium	Sept.-Jan...	300,000	268,928	289,866
Holland	Sept.-Jan...	330,000	255,592	379,770
Russia (Ukraine, etc.)	Sept.-Jan...	300,000	193,400	49,374
Poland	Sept.-Jan...	450,000	294,269	179,096
Sweden	Sept.-Jan...	175,000	71,790	231,066
Denmark	Sept.-Jan...	114,000	88,382	146,800
Italy	Sept.-Jan...	325,000	297,280	217,532
Spain	Sept.-Jan...	190,000	160,035	72,257
Switzerland	Sept.-Jan...	5,500	8,000	5,856
Bulgaria	Sept.-Jan...	40,000	16,250	12,712
Rumania	Sept.-Jan...	80,000	49,872	25,761
Total in Europe		5,294,500	4,493,562	3,973,100

United Kingdom Monthly Sugar Report.

Our last report was dated the 9th November, 1923.

The recovery in prices which had started at the time it was issued has been maintained, and a firm and increasing market was continuous throughout the last month.

In the terminal market, December had improved at the highest point from 25s. 6d. up to 31s., March and May from 25s. 3d. to 29s. The increase in prices was principally caused by the constant strength of the New York market, which only showed signs of a little reaction on the 3rd December, when our market eased in sympathy and at the time of going to press the current quotations are: December, 29s. 6d.; March, 28s.; May, 27s. 10½d.; August, 26s. 9d.

Trade in actual sugars, both spot and near at hand, has had a period of activity; and, supported by a demand for immediate requirements, the market quickly rose about 5s. a cwt. The London refiners have raised their price to this extent by a continual series of increases; other marks falling into line. A very large trade has transpired; and the refiners—even at their advanced prices—are not willing sellers, owing to their difficulty in obtaining their raw supply at a remunerative price, and to their outstanding obligations in fulfilling existing contracts, which afford a ready absorption for their output.

At one time the dearth of raw sugars was so marked that one Liverpool refiner withdrew all offers, and two other Liverpool refiners and two Scottish refiners closed entirely. All available sources of supply were eagerly sought; 33s. 6d. c.i.f. was paid for Mauritius Crystals, while 6d. per cwt. allowance was willingly paid by sellers of Continental 88 per cent. beet for slight postponements of November deliveries at a market value of about 25s. 6d. on contracts previously made at prices ranging about 20s. The U.K. refiners bought heavily at advancing prices and their purchases have included Mauritius Crystals from 30s. to 33s. 6d., and Perus and Brazils 96 per cent. from 25s. to 29s.

Foreign Refined has been sparingly offered, but in good demand for ready and December. A remarkable scarcity of spot sugars existed and the lower qualities fetched very high prices. Spot Javas sold from 52s. 6d. to 58s. 6d.; and Fine Continental Granulated sold on the spot from 54s. 6d. to 59s., but the present value is about 57s. 6d. American Granulated is still out of the question for forward deliveries. Good business has been done in Czecho Granulated, ready sold from 26s. 6d. to 31s., and November December sold from 26s. to 30s. 6d. To-day's price for ready is 29s. 9d., and for December it is 28s. 9d. value. A fair business was done in January/March from 27s. to 29s. 6d. to 28s. Dutch sugars have not been freely offered, but ready sold from 28s. to 32s., Belgium Crystals have also been scarce but small parcels were traded in at prices ranging from 26s. 3d. to 30s. 6d.

The demand for Refined in America increased in volume, and the U.S. refiners were forced to clear the market of all available supplies of Raws. Cuban 96 per cent. were again sold up to 6 cents, and full duty sugars—such as Perus and Brazils—sold up to 5½ cents, but at the moment there is a slight easing of prices, and the latest business in full duty sugars is 5 cents. A remarkable feature has been the demand in America for the early shipments from Cuba, and January clearance has been sold up to 5½ cents, but even this delivery can be bought cheaper at the time of writing.

As forecasted in our last report, Mr. F. O. Licht has now issued further revised Beet estimates for Europe showing considerable reduction in figures:—

Germany	1,125,000	against previous estimate 1,250,000 tons
France	475,000	,, ,, ,, 500,000 ,,
Holland	260,000	,, ,, ,, 310,000 ,,
Total Europe..	4,930,000	,, ,, ,, 5,105,000 ,,

The estimates even as they now stand are still regarded in well-informed circles to be on the optimistic side.

With regard to Cuba the latest reports are that the weather is favourable for the growing cane.

There have been constant rumours of exports of 100,000 tons of sugar from Germany, but so far no official confirmation of this can be obtained.

21, Mincing Lane,
London, E.C. 3.
December 11th, 1923.

Arthur B. Hodge,
Sugar Merchants and Brokers.

INDEX TO VOLUME XXV.

GENERAL INDEX.

[(N.C.) implies *Note and Comment*; (Par.) *Paragraph*; (Corr.) *Correspondence*; (Abs.) *Abstract*.]

NAMES.

PUBLICATIONS RECEIVED.

SUBJECT MATTER.